PRWeb

# Petitioning Local Action Against Dental Amalgam Contributing to Toxic Mercury Pollution

*Dentists and consumers are uniting to take an environmental approach to banning the use of mercury in the dental amalgam filling. Dental offices have been found to be major contributors of mercury in our water and fish. Dr. James Rota will be speaking at free seminar about the dangers of the silver filling to people and the environment.*

Los Angeles, CA (PRWEB) August 31, 2010 -- Grass roots groups are forming across the country to address the environmental impact of the silver/mercury amalgam dental filling in local communities. Now, concerned citizens may sign an online petition to ban the use of dental mercury. Dr. James Rota, DDS, is also hosting a free seminar on September 22, at 6:30 pm, discussing safe removal of the toxic dental silver amalgam filling, detoxification, and biological dentistry. Attendees may also sign a petition to the Santa Monica City Council to take a "green approach" to dentistry.

According to Californians for Green Dentistry, "The mercury implanted into the teeth of unsuspecting patients ultimately ends up back in our environment: (1) in our water via dental clinic releases and household toilets; (2) in our air via cremation, sludge incineration, dental clinic emissions, and human respiration; and (3) in our land via landfills, burials, and fertilizer."

Mercury is a well-known neurotoxin. Once mercury is discharged to the environment, it converts to methylmercury, a very toxic form, and bioaccumulates in fish. The EPA has designated mercury as its Number One hazardous waste. Amalgam is made up of approximately 40% to 50% mercury, 25% silver, and a 25% to 35% mixture of copper, zinc, and tin.

Dr. James Rota, DDS, a pioneer in holistic dentistry, also practices "green dentistry" by using a dental amalgam separator for the past ten years. "I won't put amalgam in anyone's mouth, and I certainly won't put it in the water supply. I am not required by law to have a dental amalgam separator in my office, but it is just the right thing to do."

Manufacturers of dental amalgam separators, such as M.A.R.S Bio-Med Processes Inc., claim that their equipment will remove 99% of mercury discharge in the dentist office wastewater. Even if the use of mercury in dental fillings was banned, amalgam separators would still be necessary to prevent contamination of the water as people have the toxic amalgam fillings removed.

Californians pay to clean up after dentists that pollute the environment with mercury while the California Dental Association lobbies to block laws that would require dentists to be environmentally responsible. Californians For Green Dentistry encourages people to tell their city council that it is time to hold public hearings to address the dental mercury pollution problem in their own community.

Further speaking of dental amalgams, Dr. Rota strongly urges anyone who is considering having the silver mercury filling removed from their teeth to ensure that procedure is performed by a dentist that adheres to the IAOMT protocols. For more information about dental amalgams and mercury toxicity, visit TALKInternational.com.

Dr. Rota holds monthly seminars about the dangers of dental amalgams, the connection of the mouth to the rest

of the body, and detoxification. The next seminar is scheduled for Wednesday, September 22, 2010, at 6:30 pm in his Westwood office. For more information about holistic or biological dentistry or details about upcoming free seminars, contact Dori Rota or visit DrRota.com.

About Dr. James Rota:
Dr. Rota offers holistic and biological dentistry in a caring and supportive environment. During his forty years in Dentistry, Dr. Rota has been a UCLA Assistant Professor and a pioneer in Dental Ergonomics, developing many work simplification standards now practiced by dentists as common procedure, including Four-Handed Dentistry. He also helped develop the protocols for safe mercury removal from the mouth, which are commonplace in Biological Dentistry today. Dr. Rota's office is located at 924 Westwood Boulevard, Suite 505, Los Angeles, CA 90024.

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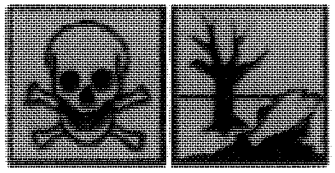
A Report to US House of Representatives
Government Oversight Subcommittee on Domestic Policy

Assessing State and Local Regulations to
Reduce Dental Mercury Emissions

# Facing Up to the Hazards of Mercury Tooth Fillings



*T Toxic*
*N Dangerous for the environment*

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**July 8, 2008**

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**This report is available via World Wide Web at: www.mercurypolicy.org**

***The Mercury Policy Project (MPP) is a project of the Tides Center and works to promote policies to eliminate mercury uses, reduce the export and trafficking of mercury, and significantly reduce mercury exposures at the local, national, and international levels. We strive to work harmoniously with other groups and individuals who have similar goals and interests.***

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**Mercury Policy Project**

## Introduction

It's becoming increasing clear that the recent improvements in technology for the non-mercury filling—most commonly the "composite"—have rendered the mercury tooth filling—aka "amalgam"—obsolete. One only has to look at the recent bans on new amalgam placement in Norwegian or Swedish dental patients or elimination of insurance coverage for amalgam restorations in Danish patients to document mercury-free tooth restoratives as a viable substitute.

Practically speaking, the age of amalgam is over.

So why do over 60 million mercury tooth fillings still get placed into Americans' mouths every year?

Is it because it is simply cheaper and quicker for your dentists to place an amalgam and they make more money doing so?

Is it because, as the expression goes, "you can't teach an old dog new tricks," and in some cases dentists are reluctant to change or take the time to master the new techniques for placement of composites?

Or is it because the US dental sector, led by the American Dental Association and its state associations, remains in denial that mercury is a neurotoxin — a hazardous material before it is placed in the mouth, and a hazard that releases toxic vapors after it is in the mouth? And could concerns about potential legal liability reinforce this denial?

Or finally, is it because dentists are not aware or held accountable to the fact—undisputed by the US EPA since it was presented to the US House subcommittee last fall-- that the continued use of amalgam is resulting in the release of upwards of 10 tons—and growing—of mercury into the air and water each year in the U.S. And that at least some of that mercury gets taken up in the fish Americans eat and, in particular, poses the most acute risk to pregnant women and their developing fetus and young children?

The answer certainly includes some or all of the above points, depending upon the expert you may be talking with.

While the calculations here are necessarily based on a certain number of assumptions, estimates and projections, the basic fact remains that up until now significant added costs of using amalgam—the so-called "externalities"—have not been factored into the fee charged by your dentist. This report demonstrates when factoring in these external costs, even under multiple scenarios, the cost of placing an amalgam filling virtually meets or surpasses the cost of placing a non-mercury composite filling.

Assuming that it is not yet politically viable for decision-makers in the US to ban amalgam outright, this report – for the first time ever-- lays out the rationale for placing a user fee on the continued use of dental mercury as a means to cover the costs of preventing dental mercury pollution from environmental release.

This report also clearly shows the cost-effectiveness of amalgam separators at preventing mercury from getting into the environment. It also clearly demonstrates that voluntary programs are not effective in convincing dentists to install and properly maintain separators.

# 1 Dental mercury, wastes and emissions

## *1.1 Mercury in the environment*

Mercury is a naturally occurring metal and a persistent, bio-accumulative neurotoxin, especially affecting the brain and nervous system. It enters the environment via natural events, such as volcanic eruptions, but more-so through human activities. Methylmercury is more mobile and even more toxic than elemental mercury, and it easily finds its way into the food chain, contaminating fish. Methylmercury is synthesized by microbial action on mercury-polluted sediments and soils. The consumption of fish from waters contaminated with mercury is the source of greatest risk of exposure to this pollutant (NACWA 2002).

While mercury releases to wastewater should clearly be avoided, most methylmercury is generated from the by-products of the combustion of mercury-containing materials. The release of mercury by combustion occurs in a variety of settings, including coal-fired power plants, municipal incinerators, sludge incinerators, hazardous waste incinerators, industrial boilers, cremation chambers and other industrial processes including metal refining and cement production.

The widely documented effects of mercury exposure on human health and wildlife have driven a great range of efforts, in the US and overseas, to significantly reduce the level of this toxic, persistent, and bio-accumulative metal in the environment. The rest of this paper will address one key source of mercury releases to the environment, which is the use of mercury in dentistry.

## *1.2 Dental mercury wastes*

The primary sources of mercury waste that originate in the dental clinic include amalgam waste generated producing amalgam for use in the procedure; the excess material carved from new amalgam fillings; the removal of old amalgam fillings; the removal of teeth containing amalgam; other mercury going to solid waste or wastewater; mercury emissions directly to the air; the traps, filters and other devices in dental clinics to remove mercury from the wastewater – and the "downstream" flows of mercury from there.

Most dental mercury waste results from the removal of previous fillings from patients' teeth. Together with waste generated during the replacing of fillings, removed teeth, etc., these dental wastes typically follow these main paths. They may be

- Captured for subsequent recycling or disposal,
- Washed down drains that lead to the general municipal wastewater system,
- Placed in special containers as medical waste, or
- Discarded as municipal waste.

It is commonly accepted that most municipal wastewater systems encounter significant levels of mercury, and it has been determined that typically close to 50% of that mercury originates from dental practices (AMSA 2002a). Some observations are summarized in the following table.

| City | Mercury load from dental offices |
|---|---|
| Duluth, Minnesota | 36% |
| Seattle, Washington | 40-60% |
| Palo Alto, California | 83% |
| Greater Boston Area, MA | 13-76% |

### *1.3 Dental mercury emissions*

Dental amalgam is a large source of mercury waste in the environment. According to EPA, "Mercury discharges [in wastewater] from dental offices far exceeded all other commercial and residential sources." (EPA 2006) EPA cited an estimate that 36 percent of mercury reaching municipal sewage treatment plants is released by dental offices. Other investigations have put the figure closer to 50 percent (NEG-ECP 2007). The costs of largely eliminating discharges of dental mercury to wastewater are assessed in Section 3 of this report.

Despite regulations regarding the characterization and disposal of mercury bearing wastes, many solid dental wastes still follow the low-cost route of disposal as municipal solid waste and are subsequently disposed of in landfills or by municipal incineration. Depending on the characteristics of the landfill, dental amalgam may decompose over time and the mercury may enter the leachate (which may itself be disposed of in a manner that permits the mercury to be released), groundwater, soils, or volatilize into the atmosphere. Studies have documented methylmercury in gases emitted from landfills (Lindberg *et al.* 2001).

Mercury from dental amalgams is also a significant source of airborne emissions. EPA has estimated airborne mercury attributable to wastewater sludge incineration to be 0.6 ton per year, but the discussion in Section 4 below provides evidence that the EPA estimate is seriously underestimated. Among other failings, EPA emissions estimates do not include total mercury emitted during the cremation of human remains. However, cremation has been shown to be a significant source - over 3 tons of emissions - due to the large amount of mercury in existing dental fillings. In comparison, the largest source of airborne mercury is coal-burning power plants, which emit an estimated 48 tons of mercury per year.

The 2002 EPA National Emissions Inventory (version 3) put atmospheric emissions related to dental mercury at 1.5 tonnes, as in the first column of the table below. The EPA numbers are compared with the more rigorous estimates submitted in testimony last fall, summarized in the second and third columns, which suggest air emissions at least 5 times higher than the EPA estimates. (Bender 2007) The EPA has not contested these revised estimates.

| Atmospheric emissions of dental mercury (tons) | | | |
|---|---|---|---|
| **Pathway** | **EPA National Emissions Inventory 2002** | **This report 2005 (low estimate)** | **This report 2005 (high estimate)** |
| **Human cremation** | 0.3 | 3.0 | 3.5 |
| **Dental clinics** | 0.6 | 0.9 | 1.3 |
| **Dental mercury sewage sludge incineration** | 0.6 | 1.5 | 2.0 |
| **Dental mercury sludge spread on land and landfilled** | n.a. | 0.8 | 1.2 |
| **Dental mercury MSW incineration and landfill** | n.a. | 0.2 | 0.5 |
| **Dental mercury infectious and hazardous waste** | n.a. | 0.5 | 0.7 |
| **Human respiration** | n.a. | 0.2 | 0.2 |
| **Total** | **1.5** | **7.1** | **9.4** |

## *1.4 Quantities of dental mercury consumed*

Contrary to what the US dental sector maintains, there has been very little evidence of reduction in the amounts of mercury used in dental restorations in recent years.

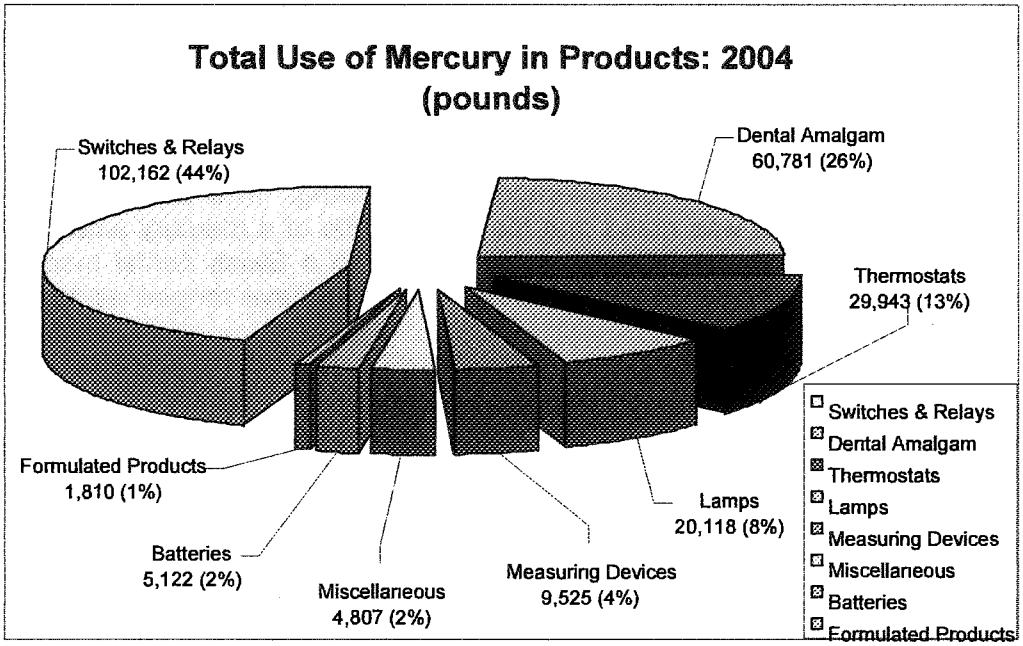
The Interstate Mercury Education and Reduction Clearinghouse (IMERC), a program of the Northeast Waste Management Officials' Association (NEWMOA), published a report online showing that mercury use in products sold in the U.S. declined from 131 tons in 2001 to 117 tons in 2004, an 11 percent reduction. The IMERC study, *Trends in Mercury Use in Products: Summary of the Interstate Mercury Education and Reduction Clearinghouse (IMERC) Mercury-added Products Database* (IMERC 2008), summarizes mercury use in products sold in the United States in 2001 and 2004 from information submitted by hundreds of manufacturers.

From IMERC's latest report, we see little change from 2001-2004 in the amount of amalgam provided to dental facilities from these five major manufacturers. For both years analyzed, 2001 and 2004, about 30 tons (61,537 in 2001 and 60,781 pounds in 2004) of mercury was used for the placement of almost 60 million amalgam fillings. This is detailed in the following table provided by IMERC.

| **Total Amount of Mercury Sold in Fabricated & Formulated Products U.S. For Calendar Years 2001 & 2004** | | | | |
|---|---|---|---|---|
| **Products/Components** | **Total Mercury (pounds)** | | **Number of Total Manufacturers Reporting** | |
| | **2001** | **2004** | **2001** | **2004** |
| Switches & Relays | 119,660 | 102,162 | 53 | 46 + 3 nr* |
| Dental Amalgam | 61,537 | 60,781 | 5 | 5 |
| Thermostats | 30,971 | 29,943 | 9 | 8 + 1 nr |
| Lamps | 21,438 | 20,118 | 177 | 185 + 8 nr |
| Miscellaneous | 8,505 | 4,807 | 12 | 10 + 2 nr |
| Batteries | 5,914 | 5,122 | 40 | 41 |
| Measuring Devices: | | | | |
| Sphygmomanometers | 4,305 | 2,219 | 2 | 2 |
| Thermometers | 5,347 | 4,524 | 13 | 8 + 4 nr |
| Manometers | 1,936 | 2,545 | 4 | 4 |
| Barometers | 353 | 234 | 1 | 1 |
| Psychrometers/Other Measuring Equipment | 4 | 3 | 3 | 3 |
| Chemicals & Solutions | 2,060 | 1,810 | 20 | 20 + 1 nr |
| **Total** | **262,030** (131 tons) | **234,268** (117 tons) | **339** | **352** |

With regard to nationwide consumption of mercury, as shown in the NEWMOA figure below, dental offices are the second largest user of mercury, after switches and relays.

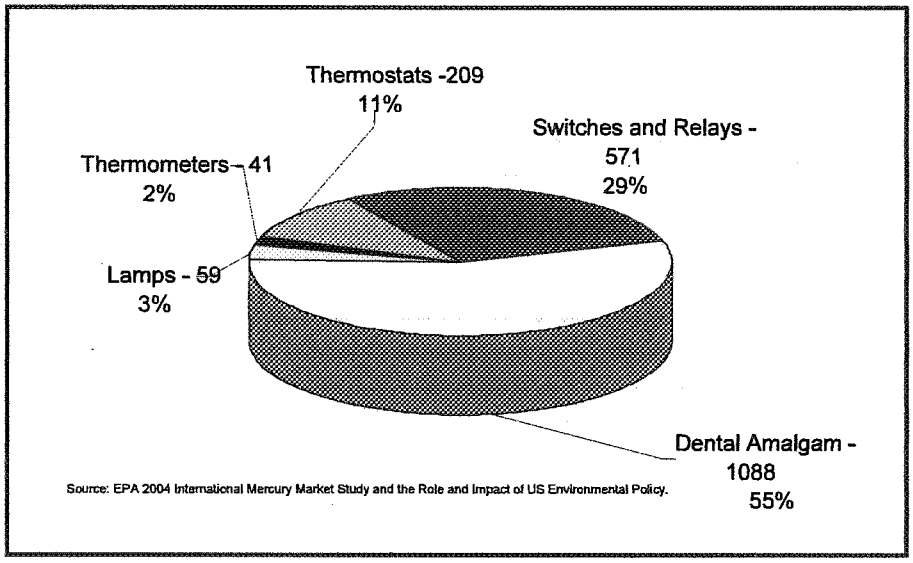
Figure 1 – Mercury consumption in the USA in 2004




Finally, as seen in the following EPA figure, mercury contained in the existing dental fillings of Americans comprises over half of all mercury "circulating in the economy" today,

amounting to over 1000 tons. (EPA 2004) All of this mercury will eventually have to be dealt with in order to keep it out of the environment.

Figure 2 - Mercury circulating in the U.S. economy




## *1.5 Quantities of mercury in dental wastes*

Following the methodology used by EPA (Cain 2007), of the 30 tons of "new" mercury consumed in a typical year by dental clinics, some amalgam is carved away or otherwise lost during a typical clinical procedure – averaging some 20-25% of the total amalgam used. However, most of the mercury lost is not due to "carving" and fitting a new filling, but due rather to the amount of old amalgam that is removed to make room for the new filling. Considering that about 70% of fillings are replacements, that not all new fillings are amalgams, etc., some 31 tons of mercury have been calculated to go to emissions and waste (Bender 2007).

The quantities of mercury consumed and mercury wastes generated by the dental profession are directly related to the average life of a filling. In a US Geological Survey report published in 2000, it was noted that the average life of a mercury amalgam filling is reported to be from 5 to 8 years, while a 1995 article in a Swiss dental medical journal reported the average life to be 10 years. Other estimates have ranged as high as 10-20 years (Reindl 2007).

# 2 Status of efforts to minimize the risks of amalgam

## *2.1 Norway, Sweden Ban Amalgam*

Starting in January 2008, Norway banned amalgam. In announcing the ban, Norwegian Minister of Environment Erik Solheim said:

> "Mercury is among the most dangerous environmental toxins. Satisfactory alternatives to mercury in products are available, and it is therefore fitting to introduce a ban. When the environmental toxin mercury is released to the environment it is very harmful, and *inter alia* the development of children may be damaged as a result."

According to the Norwegian Ministry, mercury is among the most dangerous environmental toxins. Satisfactory alternatives to mercury in products are available, and it is therefore fitting to introduce a ban. Minister Solheim further stated that the Norwegian ban shows that Norway is taking responsibility at home. It is an important signal, to the EU and other countries scrutinizing various uses of mercury, that there are satisfactory alternatives to mercury, the minister concluded.

Sweden announced a similar ban on amalgam, and Denmark announced that it will not provide public insurance to cover mercury in fillings after April 1, 2008. Such measures would be politically impossible if entirely satisfactory mercury-free alternatives were not available, or if these governments were not absolutely convinced that amalgam carries a higher risk than mercury-free alternatives.

## *2.2 FDA Settles Lawsuit, Agrees to Classify Amalgam as a Medical Device, Revamps Website*

After 32 years of delay, the Food and Drug Administration has finally agreed to comply with Federal law and set a date to classify mercury amalgam as a substance that poses a health risk, especially to pregnant women and unborn babies, and to children. This about-face resulted from settling the lawsuit, *Moms Against Mercury et al. v. Von Eschenbach, Commissioner, et al.*, in which the judge cited FDA for an "*unreasonable delay*" and "*a reasonable case of failure to act.*" As reflected in the May 16, 2008, court transcripts, Judge Ellen Huvelle stated that the "*probability of harm is enormous*," and asked the FDA: "*How could you drag your feet for 32 years? Do what you are supposed to do.*" Judge Huvelle also stated that she couldn't "*order a ban, but can compel [FDA] to act*," observing that this was "*government at its worst*" and that she wanted this "*public safety issue to be resolved.*" The FDA must now finish classification within one year of the close of the public comment period on its amalgam policy, that is, by July 28, 2009.

As part of the settlement, the FDA agreed to, and with uncharacteristic speed has already, change its website— dramatically. The updated June 3, 2008 FDA website now states, for example:

> *"Dental amalgams contain mercury, which may have neurotoxic effects on the nervous systems of developing children and fetus." ... "Pregnant women and persons who may have a health condition that makes them more sensitive to mercury exposure, including*

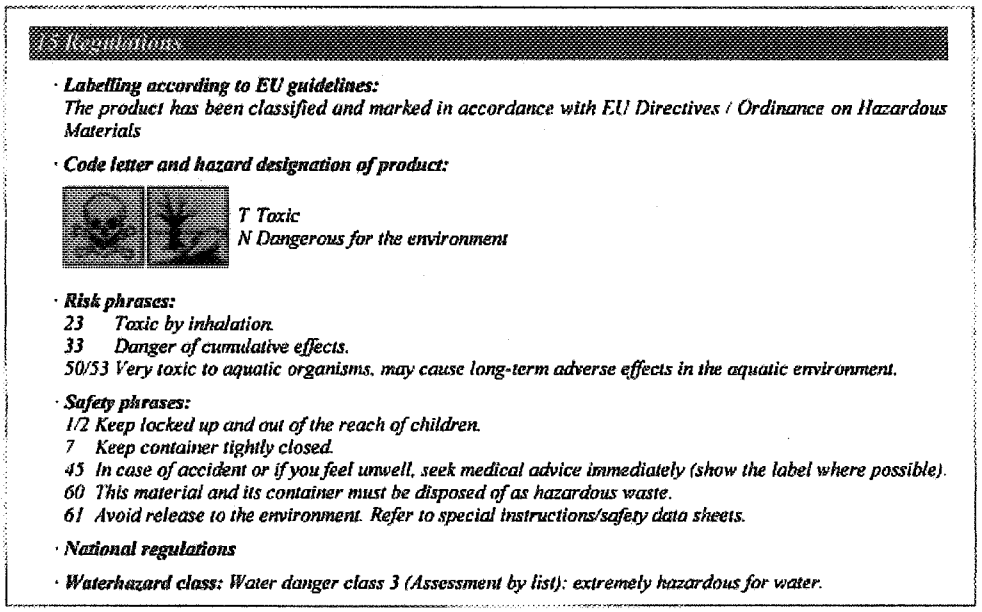
> *individuals with existing high levels of mercury bioburden, should not avoid seeking dental care, but should discuss options with their health practitioner."*

The FDA website (FDA 2007) also states, "Some other countries follow a 'precautionary principle' and avoid the use of dental amalgam in pregnant women," and provides links to advice about amalgams from regulatory agencies in other countries, including Canada, France and Sweden. For example, the FDA website link to Health Canada advises dentists to take the following measures:

- Non-mercury filling materials should be considered for restoring the primary teeth of children where the mechanical properties of the material are suitable.
- Whenever possible, amalgam fillings should not be placed in, or removed from, the teeth of pregnant women.
- Amalgam should not be placed in patients with impaired kidney function.

These warnings are similar to those sent by amalgam manufacturers. Encapsulated dental amalgam is shipped from manufacturers to a dentist's office with a skull-and-crossed-bones affixed next to the words: "*POISON, CONTAINS METALLIC MERCURY.*" (MSDS 2007) Amalgam manufacturers – Kerr, Vivadent and Dentsply, among others – advise dentists against placing amalgam in the teeth of pregnant women, nursing mothers, children under six, and anyone with kidney disease. Dentsply, for example, warns:

> "Contraindication [N.B.: "Contraindication" is a directive to forbid, not just a "warning"]: "*In children 6 and under*" and "*In expectant mothers.*"



*15 Regulations*

· ***Labelling according to EU guidelines:***
*The product has been classified and marked in accordance with EU Directives / Ordinance on Hazardous Materials*

· ***Code letter and hazard designation of product:***

*T Toxic*
*N Dangerous for the environment*

· ***Risk phrases:***
*23 Toxic by inhalation.*
*33 Danger of cumulative effects.*
*50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.*

· ***Safety phrases:***
*1/2 Keep locked up and out of the reach of children.*
*7 Keep container tightly closed.*
*45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).*
*60 This material and its container must be disposed of as hazardous waste.*
*61 Avoid release to the environment. Refer to special instructions/safety data sheets.*

· ***National regulations***

· ***Waterhazard class:*** *Water danger class 3 (Assessment by list): extremely hazardous for water.*

However, these warnings are apparently not being passed along to the public, based on the results of a national poll conducted for the Mercury Policy Project by Zogby International whereby:

- Most Americans (76 percent) don't know mercury is the primary component of amalgam fillings;
- 92 percent of Americans overwhelmingly want to be informed of their options with respect to mercury and non-mercury dental filling materials prior to treatment; and
- 77 percent of Americans would choose higher cost fillings that do not contain mercury if given the choice.

## *2.3 ADA & State Dental Associations Blocking Amalgam Separator Installations*

The American Dental Association (ADA) now recommends that amalgam separators be installed in all dental offices as part of their "best management practices (BMPs)," but they maintain that adequate levels of compliance with their recommendation can be achieved through a voluntary program. (ADA 2007) Meanwhile, they have successfully blocked amalgam separator initiatives across the country. For example, it's clear that the ADA is actively helping State Associations find ways to avoid installing separators, or block any kind of requirements to do so, at least in the following states and local jurisdictions.

California The CA Dental Association (CDA) was the sole opponent of Assembly Bill 966 in 2005, authored by Assemblymember Lori Saldaña, and stopped the bill in the Assembly. The bill would have mandated separators. In 2003, CDA was sole opponent of AB 611, authored by Assemblymember Gloria Negrete-McLeod, which also would have required separators. They actually hijacked the bill and got the author to substitute a mere codification of BMPs. The bill then died in Appropriations Committee.

Michigan In Michigan, a colleague had a very brief conversation with a MI Dental Association director who informed him that the ADA lawyer who was "helping" with the separator issue told him that they would not have to deal with the issue until 2011.

Montana According to the *ADA News,* "Immediately after the drafting of HB 665, members and staff of the Montana Dental Association, including two dentists in the Montana legislature, promptly met with the bill's sponsor, Rep. Teresa Henry. At what MDA executive director Mary McCue described as a congenial, professional meeting with a very reasonable lawmaker, the MDA explained its nearly two-year efforts, statewide, to educate dentists and promote voluntary adoption of the ADA's Best Management Practices for handling amalgam waste. The one-two punch was successful; MDA was able to convince Rep. Henry to amend her bill, who shortly removed all language Feb. 18 requiring dentists to install separators. The issue is no longer on the table. "Thanks to the assistance of the ADA, we got out ahead of the issue and it certainly helped us," said Ms. McCue.

Oregon After many delays, an amalgam separator bill was passed with an extraordinarily long compliance date (2011) due to the efforts of the lobbyist for the Oregon Dental Association. Yet the Oregon Dental Association was a bit too clever in how it arranged for such a long lead time. The provision that the ODA inserted into SB 704 deferred the effective date if the dentist is "certified by a special district that manages wastewater

treatment to be following 'best management practices.'" There are a few such districts in the state, but none of them were the least bit interested in becoming a certifying agency for 11,000 Oregon dentists. So, in Oregon's first-ever even-year legislative assembly, the ODA dropped a bill seeking a fix to SB 704, expanding the kind of entities that could certify a dentist's BMPs. Instead, a shorter time frame was adopted for the separator requirement to become law (2010).

Philadelphia Last year, the PA Dental Association blocked a proposed ordinance by the Philadelphia City Council would have required most dentists residing in Philadelphia to install amalgam separators. According to their newsletter, the PA Dental Association worked in conjunction with the ADA, its lobbyists and public relations team and other dental organizations in what they termed a "strong lobbying effort to amend the ordinance." The ADA and PDA were explaining the financial hardships that would be encountered by the Dentists and the city's poorer population because composites were more expensive and the "poor", who could not afford the more expensive fillings, would not take their children to the dentist, causing untold hardships and disease to the less fortunate.

While multiple and complex factors may influence the success, or lack thereof, of a voluntary program, there is a growing body of evidence that a mandatory approach, while administratively more demanding, is necessary to achieve a faster and more comprehensive result. Even more importantly, this creates a level playing field that does not discriminate against the vast majority of dentists who wish to comply with the ADA recommendation to install separators.

The use of amalgam separators is highly cost effective in preventing releases of mercury to the environment, particularly when compared to the cost to remove mercury at a wastewater treatment plant of approximately $21 million per pound, or $46,000 per gram (AMSA 2002b).

Recent data from the Boston area Metropolitan Water Resources Authority (MWRA) (see figure below) showed a 48% reduction in mercury concentration in sludge as amalgam separator use increased from less than 20% to over 80%. Additional data is being collected and assessed to evaluate whether these reductions are typical across the region, and to estimate the overall regional reduction in mercury releases attributable to these programs (NEG-ECP 2007).

King County in Seattle may be taken as an example. King County employed three distinct strategies to limit or control the amount of mercury discharged from dental offices over the 13-year time frame of this case study. The initial resistance of the ADA and dental community to installing separators contributed to the length of time and the changing strategies that had to be employed by the county. The King County Program 1995-2000 focused on an intensive outreach program for dentists, including an annual poster, monthly ads in a local journal, a Voucher Incentive Program, EnviroStars, information dissemination, and trade shows/mercury roundups.

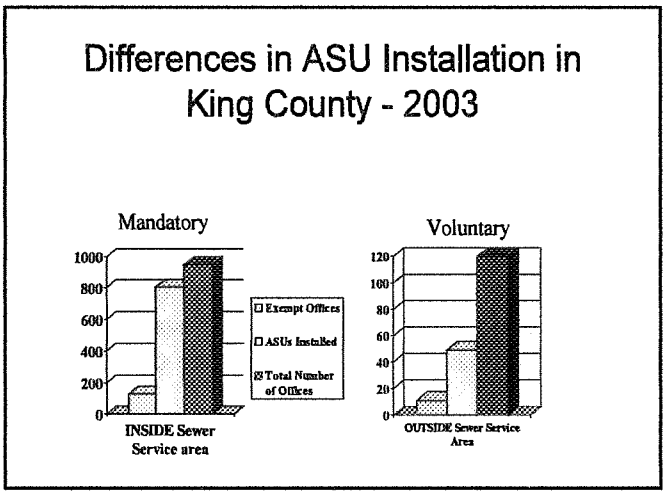
Even after these efforts, a 2000 study in King County found that more than three-quarters of dental offices did not recycle or sequester mercury-bearing waste captured in chairside traps and vacuum pump filters. Rather, they put it in the waste bin, included it with medical waste, stored it onsite for eventual disposal or flushed it down the drain (Savina 2003).

As a result, the following practices were made mandatory by July 1, 2003:

- Use best management practices (BMPs) for amalgam waste;

- Demonstrate compliance with King County local limits (0.2 mg/l) for mercury discharge to sewer (0.1 mg/l for > 5000 gpd, and 0.2 mg/l for < 5000 gpd). These limits are readily achievable for dental offices with adequate amalgam separators.

The following figure demonstrates the difference in compliance by 2003 in King County between an area with mandatory requirements and an area with voluntary requirements, despite the fact that the county's outreach program was targeted at the entire county. By 2005 there was a 97% compliance rate in the King County sewer service area – where separators are mandatory.




For these reasons, a growing number of states (9 states thus far) have opted for a mandatory requirement for amalgam separators in dental offices, either through law or regulation.

# 3 Costs of Controlling Amalgam Releases to Wastewater

The purpose of this section is to calculate the cost of removing Hg from the wastewater effluent of dental clinics. A formula to calculate this cost was developed and is explained below. (It should be noted that in order to account for uncertain developments in the future with regard to inflation, and also to facilitate cost comparisons, "constant dollars" of 2005 have been used in the calculations.)

$$C_t = N\,(E/10 + I/10 + O)$$

$C_t$ = total cost for all US dental offices
$N$ = number of dental offices requiring an installation
$E$ = average equipment cost per separator (amortized over 10 years)
$I$ = installation costs per separator
$O$ = operating and maintenance costs per year

In order to derive the total cost ($C_t$) for installing dental amalgam separators nationally, the total number of dental offices (N) was obtained from ADA records. This information included the number of dentists in general practice as well as those operating as dental specialists. These specialists include oral surgeons, orthodontists, and cosmetic dental

specialists. It could be assumed that about half of these might require amalgam separators since patients would have dental work done that would affect restorative materials and allow this material to get into the wastewater discharge from that office. We chose to use only the number of GP dental facilities for our baseline and made the worst case scenario all GP and specialist facilities having to install the separators. ADA's records indicate the number of general practice dental facilities in the USA operating at 183,480. The additional registered dental specialist facilities number 44,635, for a total of 228,115 dental facilities in operation throughout the USA.

The average costs for equipment (E), installation cost (I), and operating and maintenance (O) were derived from an industry publication on the efficacy of amalgam separators. This document made comparisons between the costs and efficacies of amalgam separators and the American Dental Association's Best Management Practice (vacuum pump filters) for diverting amalgam materials from being transferred outside the facility in wastewaters.

Three manufacturers' amalgam separators were chosen for the comparison. Equipment cost ranged from a low of $595.00 to as high as $1195.00 and averaged $846.67. This cost was then amortized over 10 years as the expected life of the system, rather than the traditional five years which is the usual IRS timeline for fully depreciating equipment. We assumed that the lifetime of the operation of the unit was a more reasonable timeframe rather than the depreciation of costs since the units were designed to operate over a longer period of time.

Estimated installation costs by the manufacturer for all options were considered to be identical. To plumb a separator into the existing systems was defined as costing $250.00 for labor and miscellaneous materials not included with the separator. This cost was also amortized over a 10-year timeframe to reflect cost over the lifetime of the unit.

Operating and maintenance costs varied with the separators. These costs ranged from $474.00 to $570.00, and averaged $528.00 per year. Included in these costs are the removal and replacement with a new separator or replacement of the filter material under a maintenance contract depending on the manufacturer's recommended O&M guidance.

Final calculation of the total annual cost ($C_t$) only for GP dental facilities to install, operate and maintain dental amalgam separators was then calculated at $117 million, with the worst case scenario for installation at all dental facilities of about $145 million.

Based on IMERC data showing that at least 30 metric tons of Hg were used in the US in 2004 for amalgam fillings, it is evident that at least 60 million amalgam fillings were placed in 2004, and probably 2005 as well, since this quantity has been relatively stable since 2001.

Therefore, the "best-estimate" cost of adequately controlling the mercury releases from one amalgam filling in the United States through the use of typical separator equipment would run $1.95 per filling in 2005 dollars, or about $2.42 per filling if all specialist dental facilities are included in the calculation as well. Based on a further sensitivity analysis, i.e., varying some of the basic assumptions, this estimate could vary by perhaps plus-or-minus 20%.

| **Dental facility amalgam separator cost per amalgam filling** | | |
|---|---|---|

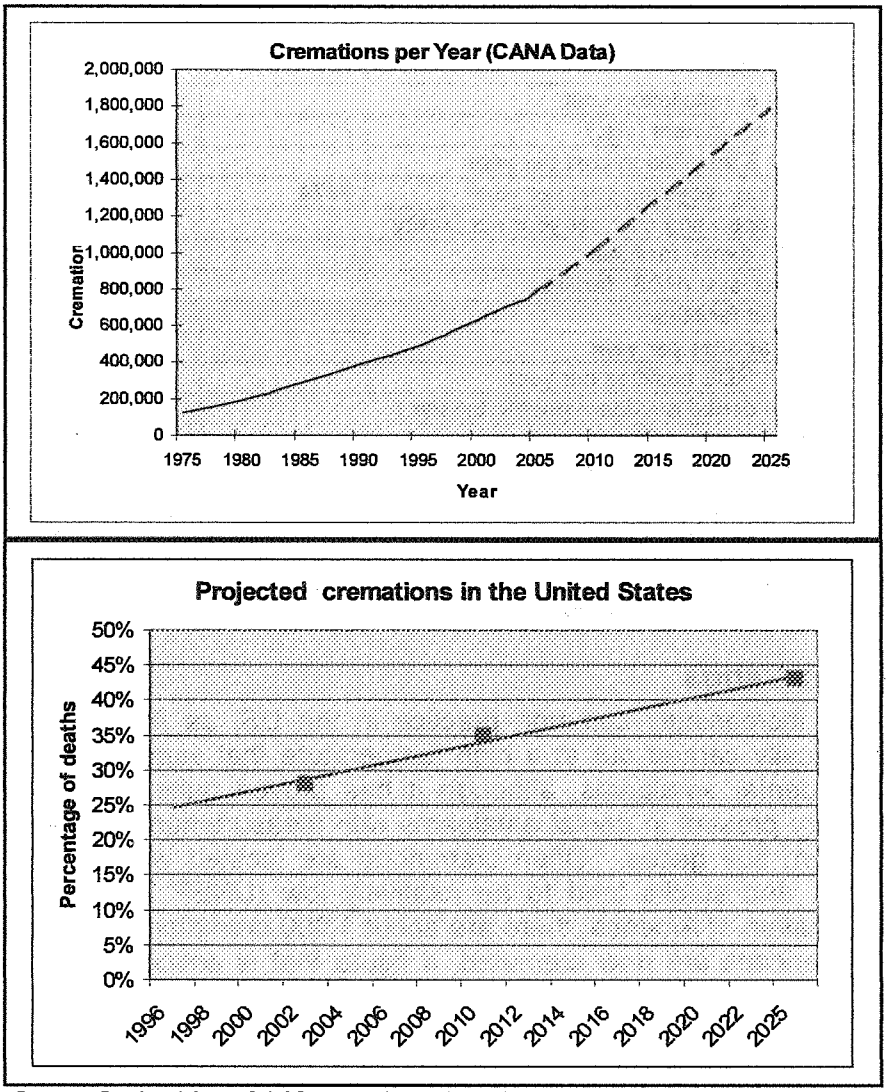
| **[All costs given in "2005 dollars"]** | | | |
|---|---|---|---|
| | low | high | average |
| Separator equipment cost | $595 | $1,195 | $846.67 |
| Equipment installation cost | | | $250.00 |
| Combined equipment & installation cost | | | $1,096.67 |
| Lifetime of separator equipment (yrs.) | | | 10 |
| Amortized equipment & installation cost per year | | | $109.67 |
| Operating, maintenance, recycling cost per year | $474 | $570 | $528 |
| Total equipment and operating cost per year per facility | | | $638 |
| General practice (GP) dental facilities | | | 183480 |
| Registered dental specialist (RDS) facilities | | | 44635 |
| Total GP and specialist facilities | | | 228115 |
| Total cost for all GP facilities per year | | | $116,999,141 |
| Total cost for all GP & RDS facilities per year | | | $145,461,408 |
| Total mercury used in dental amalgam (metric tons/yr.) | | | 30 |
| Approx. mercury per amalgam filling (gram) | | | 0.5 |
| Number of amalgam fillings placed per year | | | 60000000 |
| **Separator cost per filling for all GP facilities** | | | **$1.95** |
| **Separator cost per filling for all GP & RDS facilities** | | | **$2.42** |

# 4 Costs of Controlling Mercury Releases During Cremation

## *4.1 Cremation trends*

Cremation is an increasingly common practice in the US, as the cost of burials rises. Cremation is typically carried out at a high temperature that vaporizes virtually all of the mercury in any dental amalgams, although it has proven quite difficult to balance the amount of mercury present in dental amalgams with measurements of mercury emissions in the crematorium flue gases. Often crematoria are located within cities and close to residential areas, and stacks tend to be relatively low (UNEP 2003). According to the Cremation Association of America, there are about 1,900 crematoria in the US. Nationally, over 30% of Americans are now cremated, a figure that is anticipated to rise to 43% by 2025. Figure 3 provides an indication of US cremation trends and projections to 2025.

Figure 3 – Projected cremations in the USA (1996-2025)




Source: Derived from CSGB 2004; Reindl 2007.

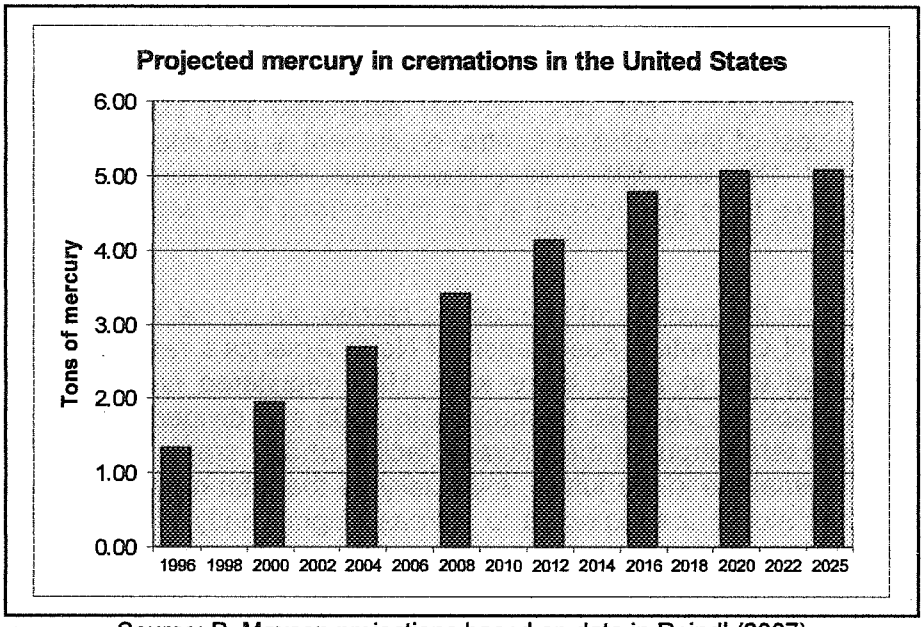
The 1998 Northeastern States Mercury Study estimated that each person cremated had an average of 2.9 grams of mercury in fillings.

Cain et al. (2007) have estimated that about 3.3 tons of mercury were emitted by crematoria in 2005. In the model used, 25% of these emissions were assumed attached to particulates, which would settle to the ground locally and be classified as land deposition, and 75% assumed to be elemental mercury emissions to the atmosphere. Based on a literature review including ground deposition studies in New Zealand and Norway (Reindl 2007), it appears justifiable to allocate up to 90% of the mercury entering crematoria as emissions to the atmosphere, with some of the balance retained, at least temporarily, in combustion equipment and the stack.

In the next 15 years, emissions from crematoria are expected to rise considerably. There are two simultaneous trends contributing to this: a rise in the average number of fillings per person cremated and a rise in the number of cremations. Figure 4 demonstrates how the

increasing number of cremations combines with the increased retention of teeth per person cremated to magnify the quantities of mercury potentially released during cremations.

Figure 4 – Rapidly increasing quantities of dental mercury to be dealt with by crematoria




Source: P. Maxson projections based on data in Reindl (2007)

## *4.2 Cremation mercury control costs*

The purpose of this section is to calculate the cost of removing Hg from US crematoria flue gases. A formula to calculate this cost was developed and is explained below. (It should be noted that in order to account for uncertain developments in the future with regard to inflation, and also to facilitate cost comparisons, "constant dollars" of 2005 have been used in the calculations.)

$$C_f = (E + L*M + L*N_c*O)/(L*N_c*N_f)$$

$C_f$ = total cost for a crematorium to treat mercury air emissions from one amalgam filling
$E$ = the total cost for equipment installation and operation
$L$ = lifetime of pollution control equipment
$M$ = the additional annual maintenance cost for monitoring emissions
$N_c$ = number of cremations per year
O = increased environmental service costs per cremation
$N_f$ = number of fillings per cremation

We were unable to find any detailed examples of flue gas control devices installed at crematoria in North America to date. On the other hand, we were able to find a report from the UK by the Department of Environment, Food and Rural Affairs used in a consultation from 2003 and 2004 on *Mercury Emissions from Crematoria*. In that consultation, costs for installation of pollution control devices and their operation were given for the crematoria in operation in the UK.

For the flue gas control equipment installation and operation, the document specifies costs consisting of equipment, building and commissioning costs, the running costs including energy, maintenance and supervision, and the purchase and disposal of sorbent used for the removal of mercury.

For (*E*) the actual flue gas control equipment purchase and installation, based on real costs at facilities in operation in the UK, DEFRA estimated this cost at about $525,000 (£265,000). The cost of this pollution control equipment is assumed here to be amortized over 15 years (*L*). This was felt to be a reasonable lifespan for these pollution control systems, although we have also looked at the implications if we were to assume a lifespan of 20 years.

In order to determine the number of cremations carried out by the typical crematorium, we took the most recent Cremation Association of North America's report from 2006. In this report it is identified that in 2005, there were 1971 registered crematoria in the United States. Next, we took the 740,698 cremations in 2005 and divided that by the number of crematoria to get a throughput of the average facility of 376 cremations. Assuming some consolidation of crematoria in the future, especially as the total number of cremations (and the number of crematoria) are expected to increase significantly in the coming years, we roughly estimated 400 cremations per year ($N_c$) at the typical crematorium during the period 2005-2020.

Estimates for the increase in operation (*O*) costs due to the presence of the pollution control were based on real cost data and placed at $17.43 (£8.80) per person cremated. These are defined as the cost for environmental services, and include the costs of additional labor, sorbent purchase and disposal, and any increase in costs for operation.

Additional maintenance costs (*M*) were included by DEFRA to reflect the need for monitoring the emission source for compliance assurance. This was estimated to run about £500-1000 per crematorium per year. For simplification, we used a conservative annual cost of $2000.

As the typical mercury releases during one cremation are estimated at 3 grams, it may be assumed that the average person cremated has about 6 amalgam fillings ($N_f$).

The final numbers we arrived at were on the order of $660,000 total costs (in 2005 dollars) for one crematorium to deal with 6,000 cremations comprising some 36,000 amalgam fillings over the period 2005-2020.

Based on these figures, the "best-estimate" cost ($C_f$) of adequately controlling the mercury releases from one amalgam filling at a crematorium in the United States would run $18.32 in 2005 dollars. Based on a further sensitivity analysis, i.e., varying some of the basic assumptions, this estimate could vary by perhaps plus-or-minus 30%.

| **Crematorium Hg treatment cost per filling** | |
|---|---|

| [All costs given in "2005 dollars"] | |
|---|---|
| | |
| **Best estimate assumptions:** | |
| Take a single facility as an example | |
| Install pollution control equipment in "base year"... | 2005 |
| Investment for pollution control equipment | $525,000 |
| Lifetime of pollution control equip. (yrs.) | 15 |
| Actual US cremations in base year | 740698 |
| Number of US crematoria in base year | 1971 |
| Actual US cremations per crematorium per year | 376 |
| Assume average yearly cremations 2005-2020 | 400 |
| Total cremations handled by this equipment 2005-2020 | 6000 |
| Average Hg per cremation (grams) | 3 |
| Average Hg per amalgam filling (grams) | 0.5 |
| Average number of amalgam fillings per cremation | 6 |
| Total amalgam fillings handled by this equipment | 36000 |
| Additional environmental services cost per cremation | $17.43 |
| Total additional environmental services cost | $104,580 |
| Annual emissions monitoring cost | $2,000 |
| Total emissions monitoring cost for this equipment | $30,000 |
| Total costs for this pollution control equipment | $659,580 |
| Total fillings cremated and sequestered | 36000 |
| **Effective crematorium Hg treatment cost per filling** | **$18.32** |

It should also be noted that the basic flue gas controls for mercury will also control dioxins/furans, so a co-benefit of the mercury controls would also be achieved.

# 5 Conclusion: Costs of Composites Similar to Amalgam When Pollution Control Costs Are Factored In

Dentists typically charge more for composite fillings than for amalgams. Dental outlets and insurance companies say these cost differences are largely due to increased time required to place composite fillings, especially in rear teeth. Consolidating dental fees in urban areas across the US, as in the table below, confirms the estimate of dental colleagues that the cost of an average composite filling is 20-25% higher than an average amalgam filling.

| | |
|---|---|
| Silver Amalgam Fillings, Permanent teeth | |
| Ave. 1, 2 and 3 surface | $108 |
| | |
| Composite Resin Filling - Front & Rear teeth | |
| Ave. 1, 2 and 3 surface | $139 |

Reference: Dental fees (2004)

In order to understand the true cost of amalgam use, however, one needs to factor in "external" costs associated with preventing mercury pollution due to amalgam. This pollution comes primarily from wastewater releases during placement and removal of amalgam, and the growing culturally acceptable practice of cremation. Ultimately, society pays for the uncontrolled mercury pollution from dental amalgam through additional pollution control costs, the loss of common resources, and the heath effects associated with mercury contamination.

Even with chair-side traps in place for biologic material control and vacuum pump filters to remove materials suctioned from a patient's mouth, dental offices can release amalgam waste as very fine material that eventually ends up at sewage treatment plants. Here, they add to the other dental mercury that we inhale or ingest that passes through our systems and into sewerage. While our mercury dose comes mostly from food (fish), one must add the mercury continually released from amalgam in our mouths. Specifically because of dental mercury, many publicly owned treatment works are out of compliance with water quality standards for their effluent. Where separators have been required, effluent levels have returned to compliance with Clean Water Act standards.

Controls that remove more than 95% of amalgam from dental office wastewater have been used for years in many practices where dentists have voluntarily installed them as a choice of conscience. Amalgam separator technology is well-refined and has been in use in numerous U.S. Armed Forces dental clinics, including a very large facility operated at the Great Lakes Naval Training Center in North Chicago, IL.

Amalgam reaches the end of its useful life when we do. As demand for cremation as a culturally-acceptable practice grows, and more people retain their teeth throughout their lives, the release of mercury into the air from uncontrolled cremation flue gases increases the amount of mercury that amalgam is responsible for releasing to the environment. As with other combustion processes used to destroy materials – such as medical waste incinerators – cost-effective pollution controls for mercury exist that can be applied to crematoria.

The following table shows that when only two of these external costs are included, the real cost of using amalgam is already quite close to that of mercury-free fillings.

| | **Amalgam** | **Composite** |
|---|---|---|
| Filling cost at the dental clinic | $108 | $139 |
| "External" costs: | | |
| - separator mercury removal | $2 | -- |
| - crematorium mercury removal | $18 | -- |
| - municipal solid waste mercury removal, etc. | ?? | -- |
| **"Full cost" of an amalgam filling** | **$128+** | **$139** |

Drawing obvious conclusions from this simple cost comparison, combined with the clear risks of using amalgam, as finally admitted by the FDA, Congress should follow in the path already blazed by some progressive European countries that have decided to adopt strong measures to either discourage or ban amalgam use.

Measures that Congress should consider include:

- Require dental clinics that replace amalgam to install and properly operate amalgam separators, and to report annually on quantities of mercury collected.
- Assess a modest user fee of $30.00 for the production of each additional mercury tooth filling, payable by the manufacturer at time of sale. Funds collected should be placed into a designated account to cover the costs of controlling mercury pollution.
- Phase-out the use of mercury tooth fillings within the next 3-5 years.

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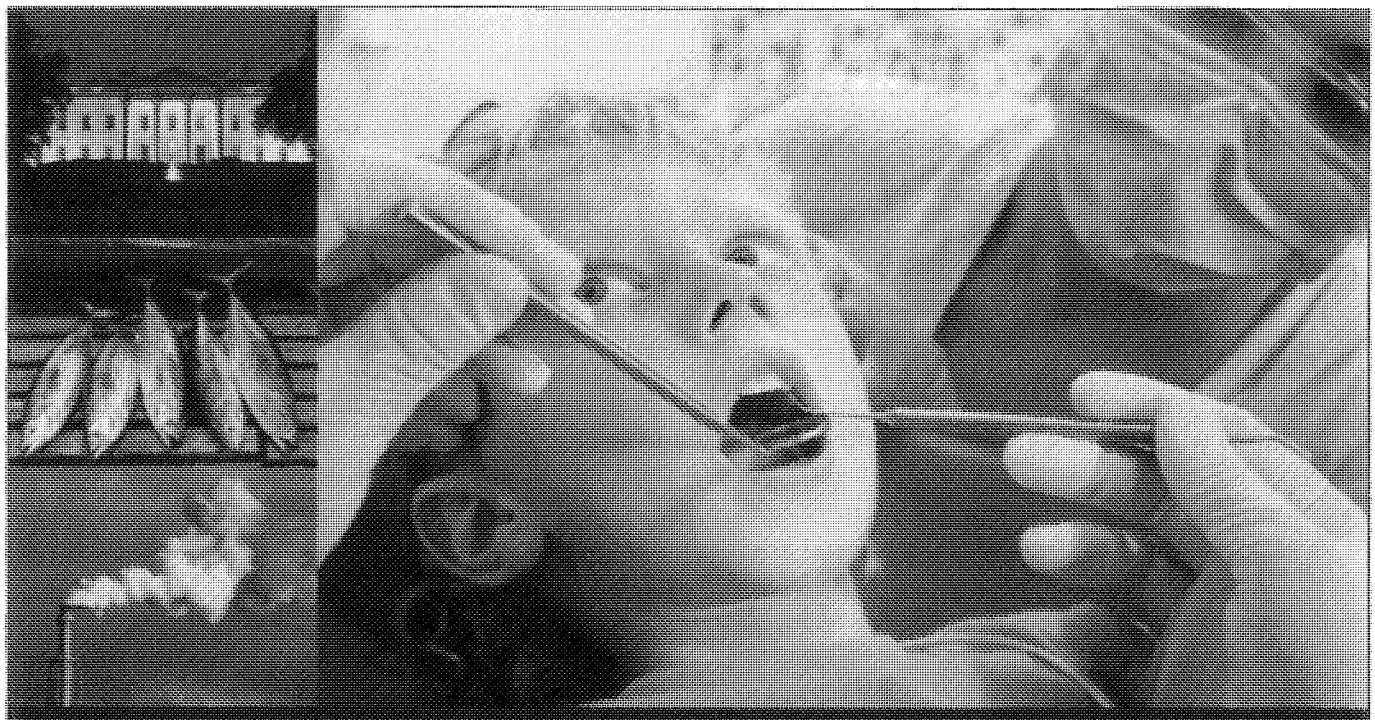

# Midnight Deal on Dental Mercury

## How the Bush EPA's agreement with the American Dental Association undermines pollution prevention

May 2010

Report by the Mercury Policy Project / Tides Center

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# Executive Summary

A hold over deal from the Bush administration is allowing tons of dental mercury pollution into the environment each year that could otherwise be prevented. The December 2008 agreement between the Bush Administration's Environmental Protection Agency (EPA), the American Dental Association (ADA) and the National Association of Clean Water Agencies (NACWA) stands in stark contrast to pollution reduction initiatives now underway for most other mercury sources both at home and abroad.

This report examines the scope of the problem of mercury pollution from the dental sector, the ADA's resistance to mandatory mercury pollution prevention strategies, opportunities to reduce mercury pollution, and the EPA's lack of action to ensure effective dental mercury pollution prevention.

During the waning days of the Bush administration, EPA political appointees let the U.S. dental sector off the hook through a midnight deal with the ADA through a Memorandum of Understanding (MOU)[1] that endorsed ADA's voluntary mercury reduction initiative and forestalled a mandatory pollution prevention program.

Dental amalgam is by far the largest source of mercury pollution to waste water treatment plants. According to EPA, "Mercury discharges [in wastewater] from dental offices far exceeded all other commercial and residential sources." EPA cited an estimate in 2007 that 36 percent of the mercury reaching municipal sewage treatment plants is released by dental offices. Other investigations have put the figure closer to 50 percent.

Mercury from dental amalgams is also a significant source of airborne emissions. Congressional hearings conducted in 2007 and 2008 revealed significant disparities between the Agency's estimate of 1.5 tons per year of dental mercury released to air compared with more recent estimates provided by an EPA scientist that was three times higher. Factoring in other amalgam air pathways that EPA left out and based on new research, this report estimates that atmospheric emissions from dental mercury could be more than six times the 2002 EPA estimate, due primarily to increasing emissions from cremation.

Securing accurate estimates of dental mercury air releases is important because the record indicates that EPA prioritizes its activities based in part on the amount of mercury releases from a particular industry sector to the atmosphere. Yet EPA continues to significantly underestimate the amount of air pollution that dental mercury accounts for, thereby rendering this problem a lower priority in the Agency's comprehensive mercury reduction strategy.

While not regulated nationally, ten states have mandated pollution control requirements (called "amalgam separators") at dental clinics. The combination of amalgam separators and best management practices can eliminate 95%-99% of dental mercury releases to wastewater.

In response to the momentum of expanding state and local mandatory programs, ADA through its state chapters has successfully organized opposition to state requirements and squashed progress since 2008. In the same year, ADA also took federal action to ensure they were kept off the hook, as the new administration prepared to take office and could have imposed a mandatory national mercury reduction program for dentists.[2]

Although not known at the time, it is clear now that the Bush Administration's EPA worked secretly with the ADA to develop a sweetheart deal for the dental sector that resulted in the MOU. State officials, environmentalists and even the EPA regional offices were not allowed in the process. Through the MOU, both EPA and NACWA bought into a program where ADA was given free rein to delay a mandatory program under the guise that a voluntary program would eventually work to prevent mercury pollution — provided that they were given enough time.

Both the Bush EPA and the ADA knew that the MOU would not significantly reduce mercury pollution. The secret contract cited one-sided or plainly erroneous sources. But the midnight deal bought time and continues to provide EPA with the rationale not to move forward with effluent guidelines for dental offices.

Clear evidence of the failure of voluntary programs had been documented by a 2008 congressional study which cited numerous cases where the programs didn't realize significant compliance.[3] Since then, the Quicksilver Caucus, a coalition of state government organizations focusing on mercury issues, has found that amalgam separator installation rates are low unless there is a mandatory component.[4]

In summary, the problem with this midnight deal is that it allows significant and preventable mercury pollution releases to the air and water. The deal was based on faulty information, left ADA in charge of developing baseline data before goals could be set, is being unduly delayed, and lacks openness, transparency and follow through. Voluntary educational outreach program might be justified for a *de minimis* pollution source, but is clearly not adequate for this significant source of mercury pollution. By following the recommendations below in timely manner, EPA can achieve significant reductions in dental mercury pollution.

# Recommendations

1) **EPA should maintain an open and transparent process to address dental mercury.** Non-governmental organizations should be recognized as full stakeholders in this process, be kept informed of all developments and allowed to participate in agency stakeholder meetings concerning dental mercury.

2) **EPA should develop regulations to prevent mercury pollution from the dental sector.** EPA should terminate the MOU and work with all relevant stakeholders to achieve significant reductions in dental mercury releases in a timely manner.

3) **EPA should update its emissions inventory and regulate crematoria.** EPA should update its outdated 2002 emissions inventory for dental mercury and correct its misrepresentation that the dental community has "made significant progress through voluntary efforts." EPA should also regulate mercury emissions from cremation, given that this source is significant and growing.

4) **EPA should establish guidelines for mercury discharges from dental facilities.** EPA should establish effluent guidelines, including installation of amalgam separators and implementation of best management practices for all dental mercury discharges.

5) **EPA technical documents should clearly state that pollution controls are required when mercury is a pollutant of concern.** EPA should coordinate within the Water Program and with the states to ensure that technical guidance clearly states that mercury controls are required where mercury is a pollutant of concern consistent with the Clean Water Act.

# Introduction

Dental facilities are a substantial source of mercury, a potent neurotoxin that is released both to water and to air. Several studies have estimated that the dental sector accounts for 50% or more of the mercury entering municipal wastewater systems, where it concentrates in the sludge. Releases to air are also significant. Mercury used in dental devices, in the form of amalgam fillings, is present in the teeth of many Americans. When the mercury from amalgam is released, it also contributes in various ways to the global mercury burden and gets taken up in the fish Americans eat.

The primary sources of mercury waste that originate in the dental clinic include:

- amalgam waste generated producing amalgam fillings for use in the procedure;
- the excess material carved from new amalgam fillings;
- the removal of old amalgam fillings;
- the removal of teeth containing amalgam;
- mercury emissions directly to the air; and
- the traps, filters and other devices in dental clinics to remove mercury from the wastewater.

Only approximately 20% of the states have mandates to adequately control releases of dental mercury into wastewater.

ADA has included amalgam separators as part of their Best Management Practices since 2007, but working with its state chapters, it has successfully blocked any further pollution prevention mandates since 2008. In addition, there are multiple air pathway releases of dental mercury to the environment resulting in significant (and growing) emissions. These releases are generally uncontrolled as well, and not acknowledged by EPA to be a significant problem. As discussed in greater detail below, neither of these sources is being adequately controlled by the EPA, and any plans for doing so appear "gridlocked," even after two congressional oversight hearings.

**Table 1. Eleven States Require Best Management Practices and Amalgam Separators**

| State | Year | Mandate |
|---|---|---|
| Connecticut | 2003 | Law |
| Maine | 2004 | Law |
| New Hampshire | 2005 | Rules |
| Washington | 2005 | Rules |
| Vermont | 2006 | Rules |
| New York | 2006 | Rules |
| Massachusetts | 2007 | Law |
| Rhode Island | 2007 | Law |
| New Jersey | 2007 | Rules |
| Oregon | 2011 | Law |
| Michigan | 2013 | Law |

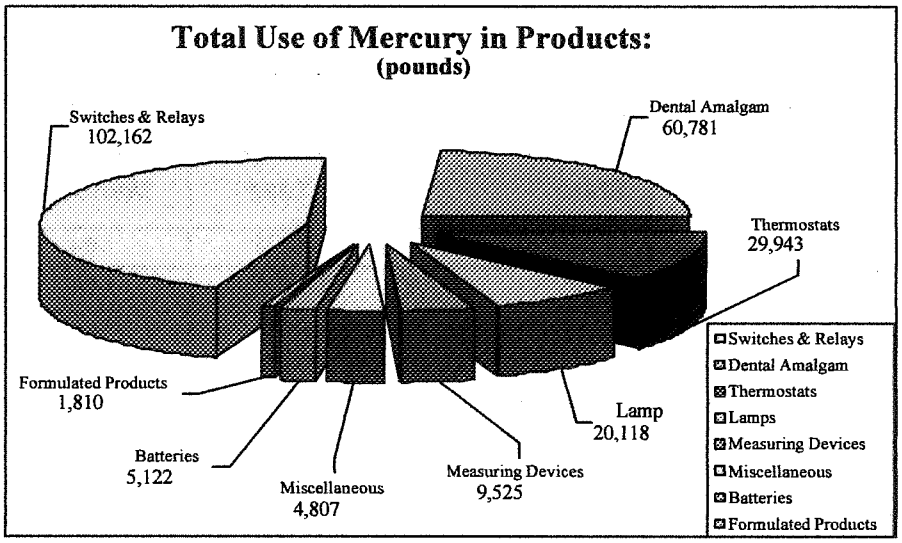
State laws and/or rules have been adopted in eleven states, and numerous municipalities, requiring employment of best management practices, including amalgam separators, in dental offices.

# Sources of Dental Mercury Pollution

## Discharges from dental facilities into water

Dental offices are the second largest user of mercury, after switches and relays, as demonstrated in Figure 1, and those large quantities add to the mercury disposal burden.

**Figure 1 – U.S. Mercury Consumption in 2004**




Amalgam use was the second largest use of mercury in 2004, according to several estimates.

Given that amalgam lasts between ten and twenty years, it is reasonable to assume that the same quantities of mercury used when they were placed will end up being disposed somewhere, if they are not collected and recycled. Mercury contained in the existing dental fillings of Americans is one of the largest reservoirs of mercury in the United States. According to an EPA estimate, dental amalgam comprises over half of all mercury in use, amounting to over 1000 tons in 2004.[6]

Mercury from amalgam waste in sewer lines results in direct discharges of mercury to waterways from combined sewer overflows during high flow storm events.

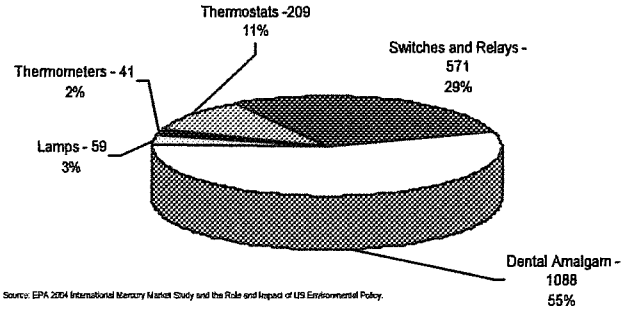
Thousands of miles of sewer pipelines have become the repository of many tons of dental mercury that will contribute to sewage treatment plant influent mercury levels for years to come. Dental mercury releases also contribute to water via human wastes, runoff from land disposal and landfilling of contaminated sewage sludges, etc.

As discussed in the next section, significant quantities of dental mercury are also released to the atmosphere when the mercury-containing residues of sewage plants is incinerated, and after the sludge is applied to agricultural land or landfilled. Elemental mercury is released during chewing or drinking liquids, as well as when corpses containing mercury dental fillings are cremated.

Studies also clearly show that dental mercury has also been shown to contaminate the fish we eat.[7] Mercury from amalgam waste may be converted to methylmercury in sewage lines and septic systems, which was confirmed in a study by a researcher from the U.S. Navy.[8] Methylmercury is not typically trapped by a sewage treatment process and is therefore discharged with the wastewater effluent or volatilizes, polluting the air. This is backed up by the following statement on EPA's website:

"When amalgam enters water, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish and ani-

**Figure 2. U.S. Reservoirs of Mercury Use**




In 2004, there were over 1,000 tons of mercury in use in tooth fillings in the United States.

mals that eat fish. Fish and shellfish are the main sources of methylmercury exposure to humans."[9]

## Emissions to air

Amalgam use contributes significant quantities of mercury pollution into the air. Yet there are major discrepancies between the outdated estimates from EPA about the total amount of emissions and other more updated estimates.

The 2002 EPA National Emissions Inventory put atmospheric emissions related to dental mercury at 1.5 tons (Table 2). The EPA numbers are compared with estimates submitted in 2007 testimony provided by the Mercury Policy Project (MPP), summarized in the second and third columns, which suggest air emissions could be more than 6 times higher than EPA estimates.[10]

As the table shows, EPA has still not developed estimated emissions for several sources, including: dental mercury in sludge that is landfilled or spread on agricultural or forest land, or that is dried before it is used as fertilizer; in infectious and hazardous waste; in general municipal waste; in human respiration; or removed as grit and fines at wastewater treatment plants and disposed of in a number of ways, including septic systems and in combined sewer overflows.

This is surprising, given that atmospheric releases of dental mercury in the United States are clearly significant when compared with other major mercury source categories (Table 3), and will be a much greater percentage once pollution controls are installed.[11]

**Table 2. Comparison between EPA Inventory and MPP Estimates for Dental Mercury Releases to the Atmosphere**

| Pathway | EPA 2002 Inventory | MPP Low Estimate 2005 | MPP High estimate 2005 |
|---|---|---|---|
| Human cremation | 0.3 | 3.0 | 3.5 |
| Dental clinics | 0.6 | 0.9 | 1.3 |
| Sludge incineration | 0.6 | 1.5 | 2.0 |
| MSW disposal | NA | 0.2 | 0.5 |
| Infectious/hazardous | NA | 0.5 | 0.7 |
| Human respiration | NA | 0.2 | 0.2 |
| **Total** | **1.5** | **7.1** | **9.4** |

While EPA estimates 1.5 tons of mercury were released into the air in 2002, high/low estimates from MPP estimated between 7. 1 tons and 9.4 metric tons of mercury released to air.

**Table 3. U.S. Anthropogenic Mercury Air Emissions Reported by EPA's National Emissions Inventory (NEI) by Source Category: 1990 and 2005**

| Source Category | 1990* Mercury Emissions (tons/yr)*** | 2005** Mercury Emissions (tons/yr) |
|---|---|---|
| Coal-fired utility boilers | 58.8 (23.9%) | 52.3 (50.9%) |
| Municipal waste combustors | 57.2 (23.2%) | 2.4 (2.3%) |
| Medical waste incinerators | 51.0 (20.7%) | 0.2 (0.2%) |
| Industrial, commercial & institutional boilers & heaters | 14.4 (5.8%) | 7.4 (7.2%) |
| Mercury-cell chlor-alkali plants | 10.0 (4.1%) | 1.1 (1.1%) |
| Electric arc furnaces | 7.5 (3.0%) | 7.3 (7.1%) |
| Hazardous waste Incineration **** | 6.6 (2.7%) | 4.1 (4.0%) |
| Portland cement non-hazardous waste**** | 5.0 (2.0%) | 7.5 (7.3%) |
| Industrial gold mining | 4.4 (1.8%) | 2.4 (2.3%) |
| Mobile sources | (NA)***** | 1.1 (1.1%) |
| Other (numerous very small sources) | 31.5 (12.8%) | 16.9 (16.5%) |
| **Total** | **246.4 (100%)** | **102.7 (100%)** |

EPA estimated nearly 250 tons of mercury released to the air in 1990, dropping to 100 tons of mercury in 2005.

* Source: EPA 1990 National Emissions Inventory (NEI), 11/14/2005.
** Source: EPA 2005 National Emissions Inventory (NEI), 2005 NATA NEI, 07/01/2009
*** Ton = short ton = 2000 pounds.
**** Hazardous waste incineration category includes Portland cement hazardous waste kilns. 1990 estimates for Portland cement and hazardous waste incineration do not use the same methodology and are underestimated in 1990 based on current data.
***** Not available. Mobile sources estimates are only available for 2002 and 2005.

## Mercury releases from sewage sludge

In its 2002 inventory, EPA estimated airborne mercury attributable to wastewater sludge incineration to be 0.6 ton per year. Yet this figure appears to significantly undercount sludge-related mercury pollution. The Northeast States for Coordinated Air Use Management estimated that mercury emissions in sludge emissions *in the northeast alone* amount to 0.5 tons per year.[12] According to a northeastern state official, sludge incineration is a significant source of mercury emissions in the northeast.

> "Sewage sludge incinerators were estimated to be the third largest point source of mercury emissions in the northeast prior to regional requirements that dentists use amalgam separators, and accounted for over 1,100 pounds of mercury or 12% of total emissions. This estimate did not include releases from wastewater or land applied sewage sludge, which would significantly increase the total."[13]

EPA admits that its mercury emission data for sludge incineration is "poor," a deficiency it attributes to both the small number of facilities tested and the fact that these facilities were not a random sample of the industry.[14]

## Mercury releases from cremation

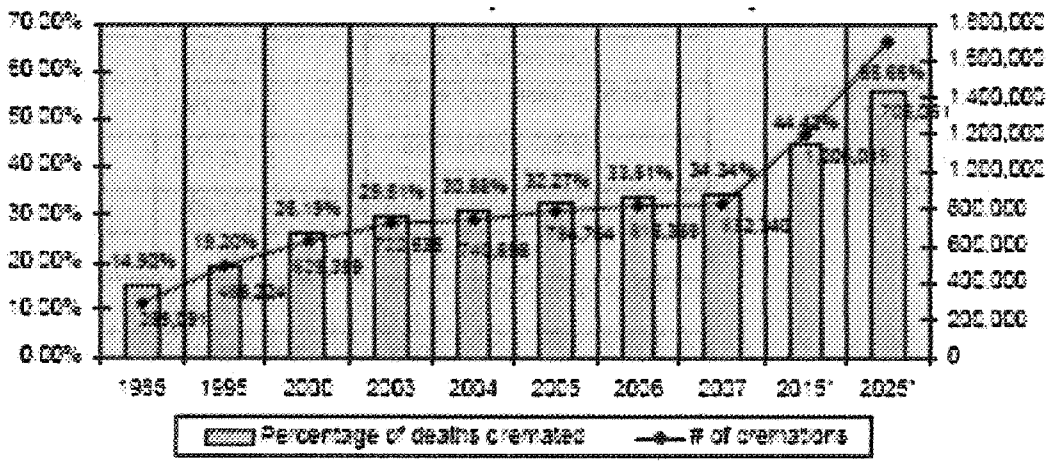
EPA's earlier estimate from cremation significantly understates the magnitude of mercury emissions. As discussed above, EPA's estimate of total mercury emitted as a byproduct of cremation of human remains to be around 0.3 tons per year. The official estimate is based entirely on one test conducted at a single crematorium 10 years ago, and does not explain the difference between the amount of mercury in fillings and the amount of mercury measured in emissions.[15] However, a 2007 published article co-authored by an EPA Region 5 environmental scientist estimates mercury emissions from cremation at about 3 tons per year, ten times the earlier EPA estimate.[16]

According to the Cremation Association of America, there are about 1,900 crematoria in the United States. Nationally, over 30% of Americans are now cremated, a figure that is anticipated to rise to just under 56% by 2025. From 2005 data, the EPA scientist estimated that about 3.3 tons of mercury were emitted by crematoria that year,[17] which is acknowledged on EPA's website.[18] In the model used by the EPA scientist, 25% of these emissions were assumed attached to particulates, which would settle to the ground locally and be classified as land deposition, and 75% assumed to be elemental mercury emissions to the atmosphere.

The chart below from the Cremation Association of America provides an indication of U.S. cremation trends and projections to 2025, which are significantly greater than earlier projections.[19]

Based on a literature review including ground deposition studies in New Zealand and Norway,[20] it appears reasonable to allocate up to 90% of the mercury entering crematoria as emissions to the atmosphere, with some of the

### Figure 3 – Cremation Data & Predictions




*Projected figures

Cremation is projected to grow significantly over the next 15 years.

balance retained, at least temporarily, in combustion equipment and the stack. This type of "mass balance" approach is often utilized for estimating releases, especially where hard data is lacking, and can be adjusted once such testing occurs.

In the model prepared for EPA Region 5, it was estimated that 30% of all deaths in the US would be handled by cremation. The data estimated 2,688,478 total deaths, with an average of 12 fillings per body, and each amalgam having an average of 0.31 grams of mercury. Thus, the amount of mercury in the restorations of those cremated was estimated as 2,961 kilograms (6526 pounds) per year.[21]

New data provided by the Cremation Association of North America (CANA) estimates that the 2010 cremation rate in the United States will be just under 36%, with 946,400 cremations, while the rate in 2020 will be about 50%, with 1,456,040 cremations. This is compared to the estimate of 796,058 cremations used in the Region 5 EPA model (29.61% of 2,688,478 total deaths). Thus, the estimate of the EPA scientist for 2010 is 25% too low compared to the CANA estimate, while by 2020, the number of cremations will be 83% larger than the estimate of the model for 2005-2010.[22]

In the next 15 years, emissions from crematoria are expected to rise considerably. The chart below from the Cremation Association of America provides an indication of U.S. cremation trends and projections to 2025, which are significantly greater than earlier projections.

There are two simultaneous trends contributing to this: a rise in the average number of fillings per person cremated and a rise in the number of cremations.[23] In the past, many corpses had relatively few – if any – of their own teeth, due to losses of teeth. For example, according to a study by U.S. Centers for Disease Control and Prevention (the National Health and Nutrition Examination Survey (NHANES)) in the late 1980s and early 1990s, the presence of teeth in U.S. adults was significantly lower among adults above age 55 as compared to younger adults. By age 55, the average adult had less than half of their teeth, while by 75, the number had fallen to less than a third of their teeth.

However, improved health care has resulted in more people retaining more teeth throughout their lives, which also means more restorations, including amalgam fillings, in corpses. This situation will change in time, as the younger generation has benefited from even better dental health care not only to retain more teeth, but to have fewer restorations.

While exact data in the United States on these trends are not available – especially the use and estimates for amalgam fillings – we can get an indication of this from work done in Europe, especially the United Kingdom (U.K.).[24]

In a U.K. report from 2003, it was estimated that the amount of mercury per cremation would increase by 42% from 2005 to 2020, based solely on the increased number of teeth, and hence restorations, per person. If the same would apply in the United States, the total amount of mercury emitted would increase by 160% due to a 83% increase in the number of cremations and a 42% increase in mercury per cremation. **Thus, rather than 6,516 pounds a year, the total mercury emission would be about 16,944 pounds per year.**[25]

The EPA has put out several documents on mercury emissions from cremation, but the data are inconsistent. In one study,[26] a value of $1.5 \times 10^{-3}$ kg (1.5 grams) of mercury per cremation is reported, from a 1992 test done in California of a propane fired crematorium. The EPA report does not provide data on the age of the deceased, or the number and size of the fillings and the mercury estimated to be contained in the fillings.[27]

## Table 4. Estimates of Mercury Emissions from U.S. Crematoria

| Year and Source | U.S. Deaths | Cremation Rate | Cremations | Mercury per Cremation | Total Mercury |
|---|---|---|---|---|---|
| 2005-2010 * | 2,688,478 | 29.61% | 796,058 | 3.72 grams | 6,526 pounds |
| 2010 ** | 2,634,000 | 35.93% | 946,396 | 3.72 grams | 8,177 pounds |
| 2020 *** | NA | 50% | 1,456,040 | 5.28 grams | 16,944 pounds |

Mercury emission from cremation are projected to more than double over the next ten years.

* EPA Region 5 Mercury Flow Model.
** CANA estimates for number of deaths and cremations, 2003.
*** Interpolation of CANA estimates for the number of deaths and cremations, 2007 trends analysis, and U.K. estimates of increased quantity of mercury per cremation on a percent basis, based on increased presence of teeth.

In the second EPA report from the same year,[28] the amount of mercury is reported at $0.94 \times 10^{-6}$ kg/body ($0.94 \times 10^{-3}$ gram/body) or less than 1/1000th of the other EPA report from the same year. The test results were said to have been obtained from a confidential test report to the California Air Resource Board (which may, in fact, be same report quoted in the other EPA report).[29]

Two years later, in 1999, EPA was a partial sponsor of a test of mercury emissions at the Woodlawn crematorium in Brooklyn, said to have been the only crematorium in the U.S. with any emissions control equipment.[30]

However, these tests were done with no apparent review of the literature of other countries, with no statistical controls on whether the bodies cremated were representative of the national cremation practices, and with no mass balances of the mercury into and out of the crematorium. Questions remain with several of the researchers found to be unhappy with either the way the tests and data quality were done as well as the way that the cremation industry has used the data.[31]

At this time, there are no standards for regulating mercury emissions from crematoria in the United States. Under Section 129 of the Clean Air Act, EPA is required to set standards for a variety of air sources. Originally, the standards for crematoria were to be developed by November 2000, and in a *Federal Register* notice at that time, EPA set a new schedule to release its standards by November 15, 2005. However, EPA came to the conclusion in 2004:

> "... that the human body should not be labeled or considered 'solid waste.' Therefore, human crematories are not solid waste combustion units and are not a subcategory of OSWI for regulations. If EPA or States determine, in the future, that human crematories should be considered for regulation, they would be addressed under other authorities."[32]

Yet other countries, including the U.K., have recognized mercury emissions as a significant source and have set standards to reduce pollution. Standards were set in the U.K. in the fall of 2004 and then further revised in the spring of 2005.

The original standard called for no regulation of existing crematoria and, for new crematoria, a maximum release of 150 milligrams per four cremations, with a concentration limit of 50 micrograms/cubic meter of exhaust gas. In the revised standard, 50% of all cremations at existing crematoria are to be subject to mercury abatement, with a deadline of 31 December 2012. The regulations allow for "burden sharing" – instead of each crematorium installing controlling equipment, several crematoria can share the cost of abatement equipment so that 50% of the cremations of the pooled crematoria have mercury abatement.[33]

# EPA Fails to Cut Mercury Pollution

## Hearings fail to motivate EPA to push for dental mercury reduction results

Due to the dental sector's significant contribution of mercury into the environment, the Domestic Policy Subcommittee held hearings in November 2007, *Environmental Risks of Mercury Dental Fillings*, and July 2008, *Assessing State and Local Regulations to Reduce Dental Mercury Emissions*. The hearings included testimony from federal officials, dental professionals and organizations, amalgam separator manufacturers, environmental experts and state and local government officials who have championed efforts to reduce dental mercury pollution, and found that:

> "The most widely used and best known technology to prevent mercury solids from entering dental wastewater discharge is known as an amalgam separator unit. An amalgam separator is a wastewater treatment device installed at the source, rather that the POTW, that removes 95 to 99% of the mercury from dental wastewater."[34]

Subsequently, Domestic Policy Subcommittee Chairman Dennis Kucinich asked then-EPA Administrator Steve Johnson for a response to testimony provided at the hearings,[35] particularly related to the Agency's outdated 2002 emission inventory estimates for dental mercury. As discussed earlier, air releases were estimated to be more than 6 times higher than the EPA's 2002 estimates.[36] The Kucinich letter noted that "EPA has even expressed a lack of confidence in some of its estimates" and "... furthermore, there are a number of other emission pathways for which EPA has failed to develop any estimates."

EPA continues to cling to its increasingly outdated dental mercury air estimates from 2002. For example, a March 6, 2008 EPA response to Chairman Kucinich reaffirmed the Agency's 2002 estimates that roughly 1.5 tons of dental mercury is emitted each year, of which 0.3 tons is emitted from cremation; 0.6 tons emitted from sewage sludge incineration; and 0.6 tons emitted from dental preparation. Yet the letter also suggests that "these estimates could be as much as two times higher."[37]

A follow up letter was sent from Chairman Kucinich to the EPA Administrator in January 2010, again honing in the discrepancies between the EPA dental mercury releases to air versus those presented during the congressional hearings.[38] While the April 5, 2010 response indicated that the Agency was very committed to reducing mercury pollution both at home and abroad, few specifics were given in response to the questions raised in the congressional letter.[39]

EPA's reply to Kucinich's inquiry raised specific concerns: EPA's apparent unwillingness to update it estimates of mercury emissions from crematoria or develop emissions factors for other air pathways. EPA's letter states that there is a lack of good empirical data on mercury emissions from crematoria, but doesn't provide a plan for gathering such data. Yet this information is available outside the United States, and it would not be costly to obtain this data or, in the interim, utilize a mass balance approach, as described earlier in this report.

Further, it is critical for EPA to address this issue now, since the number of cremations is rapidly rising and, simultaneously, the number of amalgam fillings per body cremated is rapidly increasing.[40] This "perfect storm" combination is resulting in increasing mercury releases from a significant source that the EPA still mistakenly underestimates at only 0.3 tons per year.

## EPA-ADA MOU perpetuates delays in reducing dental mercury pollution

EPA has had a history under previous administrations of ignoring the significant and growing discharge of dental mercury and instead promoting voluntary initiatives by the ADA even where mandatory programs were indicated. ADA initiated its voluntary program for best management practices (BMPs) in 2003. In October 2007, the ADA's BMPs were amended to include the recommended use of amalgam separators.[41] The ADA published its first report in 2002 on amalgam separators, followed by articles in 2003 and 2008.[42] Therefore, the need to install amalgam separators as part of BMPs to protect the environment was well-established years ago.

In the waning days of the Bush administration, political appointees gave the U.S. dental sector an avenue to avoid the mounting pressure for national regulations to require dentists to reduce their mercury pollution.[43] On December 29, 2008, EPA, ADA and the National Association of Clean Water Agencies (NACWA) signed an MOU to ad-

dress the issue of dental mercury discharges and suggest installation of separators as a "voluntary" program. As stated in the MOU, EPA "...did not identify...the dental sector...for rulemaking" because they have demonstrated "...significant progress through voluntary efforts" and were therefore "a lower priority for effluent guidelines, particularly where such reductions are achieved by a significant majority of dentists utilizing amalgam separators."

Even though found to be false, this is the same rationale ADA uses on its website today to placate EPA and foster continuing delays.

> "Last year the Environmental Protection Agency (EPA) announced plans for a 'Study of a Pretreatment Requirement for Dental Offices,' pointing to the possibility of a national mandate for amalgam separators. The ADA argued that a national pretreatment standard for dental offices was not necessary because dentistry was already acting voluntarily to address environmental impacts from dental amalgam. The ADA pointed out support of its position that the use of amalgam separators is part of the ADA's Best Management Practices (BMP). The EPA agreed and concluded that a national standard was not warranted at that time. Following this, EPA proposed an agreement among EPA, ADA and National Association of Clean Water Agencies (NACWA) to further promote voluntary compliance with ADA's BMPs, including the use of amalgam separators."[44]

Unfortunately, the Bush EPA believed the myth that voluntary programs could achieve adequate dental mercury pollution reductions, as stated in their MOU.[45] It was also used as EPA's rationale in its Final 2008 Effluent guidelines for dental clinics in 2008.

> "EPA....did not identify the dental sector for an effluent guideline rulemaking because as EPA has found with other categories of dischargers, 'demonstrating significant progress through voluntary efforts' gives that category 'a lower priority for effluent guidelines or pretreatment standards revision, particularly when such reductions are achieved by a majority of individual facilities in the industry."[46]

Yet comments sent into EPA earlier this year by the Quicksilver Caucus clearly refute this.

> "QSC members believe that US EPA should pursue effluent guidelines rulemaking for dental facilities that focus on BMP use and amalgam separators in the sector. We do not agree with the US EPA decision in 2008, when it did not identify the dental sector for effluent guidelines rulemaking..."[47]

Under the terms of the MOU, the ADA was to establish a baseline by July 2009 from which progress would be measured and interim goals were to be set by January 2010. ADA provided a baseline Separator Report as scheduled in the MOU.[48] ADA offers through its "Web-Based Survey" that all states reported that 51% of dentists use a separator, and 36.3% in non-mandated states use separators. Yet ADA suggests there is a host of confusing data suggesting a difficult time understanding the data collected to provide an accurate baseline.[49]

Yet state officials dispute such findings, reaffirming that the relatively low overall rate of amalgam separator usage appears to be inconsistent with a finding of "significant progress through voluntary efforts."[50] A national review of various dental mercury amalgam programs by the Quicksilver Caucus found that voluntary efforts have not resulted in reductions by a majority of dental offices. In April 2008, the officials released a white paper comparing the effectiveness of voluntary with mandatory components. The report indicated that dental amalgam separator installation rates were low unless there was a mandatory component.[51]

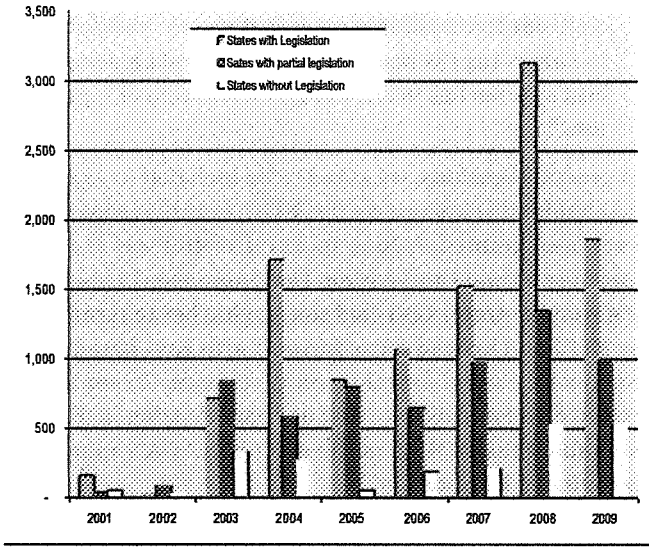
Under the current limitations of the MOU, the best available basis for understanding a baseline is amalgam separator manufacturers' data. In fact, we recommended that EPA look into this nearly a year ago, to no avail.

Not until recently has EPA finally requested that manufacturers offer amalgam separator sales data as a way to develop baseline data. Two companies did not report sales data, but others did. SolmeteX, representing about 70% of the systems sold, provided detailed sales figures.

The data in Table 5 provides a view by state of the number of systems sold in regulated, partially regulated, and non-regulated states. Based on the number of system sales sold by SolmeteX, only 13% of the separators sold have been sold in non-regulated states from 2004 through 2009.[52]

Reading further into the MOU, the discussion appears to indicate that once a baseline is established there would need to be an incremental increase in the number of separator installations per year. So, hypothetically, if the goal is established for a 10% per year increase, at an estimate of 35,000 dental clinic installations, it would take approximately 30 years to gain full compliance.

## Table 5. Partial Estimate of Amalgam Separator Sales, 2001-2009




Amalgam separator sales are far greater in states with mandates or partial mandates, than in states without requirements.

Yet well before this, clear evidence of the failure of voluntary programs was documented by a 2008 congressional survey.[53] For example, a ten-year voluntary program in San Francisco resulted in an 8% compliance rate by dentists in installing pollution control devices, called amalgam separators. A similar initiative failed in King County, Seattle, Washington when the local treatment facility entered into an MOU in 1995 to promote use of amalgam separators. After six years, only 2.6% of dentists had installed separators. By contrast, state program with mandatory programs achieve compliance rates approaching 100% of the dentists who routinely remove amalgam fillings.

Also under the MOU, ADA has also generally failed to "expand its program to raise awareness...on the benefits of following the ADA BMPs and the proper ongoing operation and maintenance of the ADA BMPs." The one piece of literature available on the internet that we have been able to find explains that:

> "Dentistry Self-Regulates: A premise of the EPA's decision not to issue a pretreatment standard is the willingness of dentists to act voluntarily. It's important to show that we are making progress to follow the ADA's BMPs and that voluntary installations of amalgam separators is increasing."[54]

The MOU also states that "Not later than one year after the effective date of this MOU (Dec. 2009), the parties intend to establish interim goals" for a "significant increase in the use of amalgam separators." Yet a date for establishing interim goals has not yet been set by EPA.

Further, the EPA, through the EPA-ADA MOU and the Agency's inaction on amalgam mercury, has created a situation where a state law has been enacted[55] to prevent municipalities from controlling mercury from dental dischargers as required by the Clean Water Act and its implementing regulations at 40 CFR Part 403. A regional EPA, after almost two years, has expressed concern about the law.[56]

Clearly, the MOU is a stall tactic to provide for more delays to the adoption of requirements to install amalgam separators. Dentists will only begin reducing mercury pollution right before mandates kick in, according to a congressional study completed after two hearings in 2007 and 2008. The report found that mandatory programs, or voluntary programs backed up with the threat of mandatory programs, are "the most effective model for achieving the desired reduction in mercury releases." In addition, they found that "...whether local dental offices had six months to meet the provision or four years, most practices rushed to be compliant in the last two months before the compliance deadline."[57]

## EPA lacks openness and transparency with its dental mercury initiatives

In contrast to the Obama Administration's commitment to openness and transparency, EPA Office of Water efforts at truly engaging NGOs as stakeholders have been lacking when it comes to its dental mercury initiatives. While EPA has written two letters over the past year welcoming "...ongoing interest in (EPA) efforts to reduce mercury discharges into the environment" and "our valuable insights,"[58] their actions speak louder than words. Agency staff have refused repeated requests to provide any updates in writing, seriously engage us as stakeholders, or take our input seriously.

Most recently, an April 5, 2010 letter from EPA to Rep. Dennis Kucinich, Chairman of the Domestic Policy Subcommittee, included the following erroneous statements concerning our involvement related to the Agency MOU with ADA on dental mercury reduction:

> "We also expanded our coordination with stakeholders to include the Quicksilver Caucus, a coalition of State environmental associations who are con-

## Taking A Closer Look at the Numbers

- EPA estimates there are 122,000 facilities which would require the installation of amalgam separators. A recent ADA marketing document suggests the ADA Masterfile includes all U.S. dentists and dental students.
- Dentists are broken down by state with a suggested total of 228,115 dentists with 44,575 representing specialists and 184,480 representing general practitioners. Dental specialists in orthodontics, oral and maxillofacial surgery, periodontics, and oral and maxillofacial pathology are not likely to require an amalgam separator.
- This leaves 184,480 general practitioners. Assuming a conservative one-third reduction for multiple dentists per practice, this leaves 121,756 dental facilities which would need amalgam separators, roughly the same as EPA's estimate of 122,000 facilities.
- ADA suggests there are 26,500 systems sold by reporting manufacturers. Assuming 10,000 more units sold by the two remaining amalgam separator manufactures not providing data, this would suggest 36,500 separators sold in the United States. With 122,000 facilities placing or removing amalgam, this represents approximately 30% installation of amalgam separators in the United States. Assuming 15,000 additional separators sold by non-reporting manufactures would represent only a 34% installation of amalgam separators. This appears to call the ADA's assessment of 51% compliance nationally into question.

The survey data offered by ADA appears inflated and with ADA and/or its state dental chapter's track record of actively opposing separator requirements it should be of little surprise. ADA continues to present information to its membership on the web:

"Dental amalgam has little effect on the environment. Less than one percent of the mercury released into the environment comes from dental amalgam. Even this amount is not in the form found in fish, which is the greatest concern."[59]

cerned with mercury discharges, and also with the Mercury Policy Project, which is an NGO focused on reducing mercury from all sources. As all the parties continue to coordinate on next steps, we look forward to narrowing the performance goals and agreeing on best approaches to encourage installation of separators."

On several occasions, we asked to be included in Agency stakeholder discussions on the MOU, but this request has never been granted. A June 15, 2009 a letter was sent from over 25 state and national environmental groups to EPA Administrator Lisa Jackson, urging her to terminate the MOU and instead move forward with goal-based regulatory controls and dental mercury releases. In our letter, we also expressed dismay that our participation in discussions about the MOU is contingent upon ADA's approval, according to EPA staff.[60]

The July 20, 2009 response back from EPA Office of Water states that "As our senior political advisors are confirmed by the Senate and assume their responsibilities as Assistant Administrators, the Agency will have the opportunity to consider the larger issues of a comprehensive mercury strategy..." and that EPA will defer on the decision on "the withdrawal from the MOU until EPA has an opportunity to consider the larger issue of a comprehensive strategy."[61]

In our follow up email, we raised questions about ADA, in terms of complying with the terms of the MOU to develop a baseline report estimating the current level of amalgam separator usage and to establish a tracking program. In addition, his email stated that this slippage may also have implications on establishing interim goals within one year (Dec. 2009) and, most importantly, affect the overall goal of the MOU to "... demonstrate a significant increase in the use of amalgam separators within a reasonable amount of time..."

# Conclusion

In summary, it is clearly more cost effective to eliminate mercury from a waste stream prior to trying to address it at the end of the pipe or when it is being incinerated. According to a study conducted by the Quicksilver Caucus, initiatives in several states demonstrate that the dental sector is significantly reducing mercury pollution through implementing Best Management Practices, which include the installation and proper use of amalgam separators.

An example of such reductions is a publicly owned treatment plant in the Minneapolis/St. Paul area which has cut influent levels in half now that its dental clinics have installed amalgam separators. Another example is the Massachusetts Water Resources Authority (MWRA). MWRA operates the largest wastewater treatment plant in Massachusetts, servicing about 2.5 million people. When amalgam separator use increased to over 80%, mercury levels in MWRA sludge decreased by about 48%.[62]

In another example, in a rule current EPA Administrator Lisa Jackson authorized when she was Commissioner of the New Jersey Department of Environmental Protection, it was noted that the annual cost per pound of mercury removed from dentists' offices through the use of pollution control equipment (combination of best management practices and operation of amalgam separators) was far less than the cost per pound of capturing mercury from incinerator flue gases:

> "...ranges from $5,100 to $7,700 (including costs associated with compliance with the BMP and recycling of captured material). In comparison, these cost estimates are far lower than the range of costs estimated by the Department for other types of facilities that are now required to reduce mercury emissions. For example, in the Department's proposal for air pollution control regulations (see 36 N.J.R. 123(a)), which have since been adopted (see 36 N.J.R. 5406(a)), the Department estimated that the costs for the installation or upgrading of mercury emission controls by municipal solid waste incinerators, iron and steel manufacturing facilities, and coal-burning utilities would be in the range of $5,000 to $40,000 per pound of mercury reduced."[63]

# Recommendations

1) **EPA should maintain an open and transparent process to address dental mercury.** To uphold the Obama administration's commitment, EPA must maintain an open and transparent process. Non-governmental organizations (NGOs) should be recognized as full stakeholders in this process, be kept informed of all developments and allowed to participate in Agency stakeholder meetings concerning dental mercury.

2) **EPA should develop regulations to prevent mercury pollution from the dental sector.** EPA should terminate the MOU and work with all relevant stakeholders to draft an agreement to achieve significant reductions in dental mercury releases in a timely manner through "goal based" regulatory controls, including mandatory employment of best management practices and amalgam separators

3) **EPA should update its emissions inventory.** EPA should update its outdated 2002 emissions inventory for dental mercury and correct its misrepresentation that the dental community has "made significant progress through voluntary efforts." EPA should regulate mercury emissions from cremation, given the increasing significance of this source.

4) **EPA should establish guidelines for mercury discharges from all dental facilities.** EPA should establish Effluent Guidelines, including installation of amalgam separators and implementation of other Best Management Practices (BMPs), for dental discharges of amalgam mercury, as it does for other sectors of businesses engaged in similar activities. As with other effluent guidelines, this would assure that a minimum level of treatment is implemented by all covered dental facilities reduce mercury, guaranteeing a level playing field for all dental facilities. This would continue to allow state and local governments to regulate sources with more specific controls if mercury discharges were identified as a problem.

5) **EPA technical documents should clearly state that pollution controls are required when mercury is a pollutant of concern.** EPA should coordinate within the Water Program to ensure that guidance states that mercury controls are required where mercury is a pollutant of concern consistent with the Clean Water Act. EPA has provided confusing and contradictory language in its recent methylmercury permitting guidance.[64] The April 2010 EPA guidance reflects the EPA-endorsed ADA stance that even where mercury being discharged to the environment is exceeding a permit limit or water quality standard (e.g. Great Lakes),[65] EPA will go no farther than recommending voluntary amalgam separator installation and other BMPs for dental facilities. This continues the Agency's acquiescence to the ADA by allowing variances to mercury water quality standards for the Great Lakes and other sensitive waters rather than clear, mandatory requirements for reducing mercury discharges to the environment.

# Endnotes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**DENTAL AMALGAM MERCURY SOLUTIONS** www.flcv.com/dams.html
DAMS 12164 Whitehouse Rd Tallahassee, Fl 32317

## THE ENVIRONMENTAL EFFECTS OF AMALGAM FILLINGS AFFECT EVERYONE

THE FOLLOWING FINDINGS ARE DOCUMENTED IN THIS Review Paper:

1. **Human excretion into sewers by those with amalgam dental fillings along with dental office amalgam waste have been documented to be the largest source of mercury into sewers and septic tanks.**

2. **All sewer plants in the U.S. have high levels of mercury and all sewer sludge has dangerous levels of mercury (generally 1 to 3 ppm).**

3. **Dental amalgam fillings are a major source of mercury going into rivers, lakes, and bays, both from dental offices and human wastes in home and office sewers. Dentistry is the third largest use of mercury in the U.S. using 45 tons per year most of which ends up in the environment.**

4. **Mercury pollution is widespread in U.S. rivers, lakes, and bays; with dangerous amounts of mercury commonly found in freshwater and saltwater fish. Over 50% of Florida's rivers and lakes have warnings regarding eating the fish and most bays. Over 33% of all U.S. lakes have fish consumption warnings, 15% of all U.S. river miles, 90% of Atlantic coastal miles, and 100% of all Gulf coastal miles. Most Gulf Coast salt water predator fish species have high levels of mercury (above EPA/FDA warning level)**

5. **Mercury is the most toxic substance commonly encountered, and is adversely affecting the health of millions of people in the U.S.**

6. **If sewer sludge is incinerated, most of the mercury goes into emissions.**

7. **Crops grown on land using sewer sludge pick up high levels of mercury. Soil bacteria in landfills and land spread sludge areas methylate mercury to methyl mercury, which is released in methane and landfill gas in high levels. High levels of mercury are being found in rain all over the U.S.**

8. **Dental Amalgam fillings are the largest source of mercury in most people and levels of mercury exposure from amalgam commonly exceeds Government Health Guidelines**, with high levels in human excretion wastes documented.

9. **The level of mercury in all sewer plants in the U.S. exceeds the U.S. Environmental Protection Agency(EPA's) proposed mercury limit for mercury in water due to the large amount from amalgam in sewers from dental offices, homes, and businesses.**

10. **Crematoria emissions commonly violate mercury air emission standards and are a significant source of mercury emissions due to mercury in amalgam fillings. Amalgam related air emissions exceed coal plant emissions in UK.**

11. **Due to the high mercury releases from dental offices, most European countries require amalgam separators in dental offices but the U.S. still has no regulations**

**on this source of mercury. Due to the major environmental effects of mercury from amalgam fillings, plus the additional known adverse health effects, most Japanese Dental Schools no longer teach the use of mercury amalgam fillings and several other countries have voted to ban amalgam use or issued warnings regarding its use, as have several U.S. states.**

Documentation:

Mercury is one of the most toxic substances commonly encountered, and according to Government agencies causes adverse health effects in large numbers of people in the U.S.[1,20] The extreme toxicity of mercury can be seen from documented effects on wildlife by very low levels of mercury exposure. The amount of mercury in the marine environment is increasing 4.8% per year, doubling every 16 years(16). Some Florida panthers that eat birds and animals that eat fish containing very low levels of mercury(about 1 part per million) have died from chronic mercury poisoning(17). Since mercury is an estrogenic chemical and reproductive toxin, the majority of the rest cannot reproduce. The average male Florida panther has higher estrogen levels than females, due to the estrogenic properties of mercury(17).Similar is true of some other animals at the top of the food chain like polar bears, beluga whales, and alligators, which are affected by mercury and other hormone disrupting chemicals. Mercury in whalemeat has been found to be high enough to cause acute toxicity from one meal. Several liver samples contained over 1000 ppm mercury, over 2000 times the Japanese health standard. Muscle samples contained 2.5 to 25 times the health standard (25). The Japanese government's limit for mercury contamination, 0.4 micrograms per gram(25). According to the U.S. EPA, the maximum advisable concentration of methylmercury in fish and shellfish tissue to protect consumers among the general population is 0.3 ppm(25b). Several European countries including Sweden have banned use of amalgam fillings, with the environmental releases being a major factor(5b).

Mercury has been found to be so toxic that the drinking water standard for mercury is 2 parts per billion(ppb). But U.S. EPA have found that because mercury bioaccumulates in the environment and fish, in order to protect from accumulation in fish and wildlife and human health even lower standards appear to be needed and lower standards have been proposed or adopted in many areas(14). The Great Lakes Initiative Wildlife Criteria calculated needed to prevent accumulation in fish and wildlife is 1.3 nanagrams per Liter(ng/L) while the GLI Human Health Criteria is 3.1 ng/L(parts per trillion). The EPA Fish Tissue Methyl Mercury-based Criteria for rivers is 7.8 ng/L and for lakes is 3.5 ng/L. The California Toxics Rule Saltwater Criteria is 25 ng/L(14). The EEU limit on mercury in sewers is 50 micrograms per liter(31).

The average amalgam filling has more than ½ gram of mercury, and has been documented to continuously leak mercury into the body of those with amalgam fillings due to the low mercury vapor pressure and galvanic current induced by mixed metals in the mouth(20). Amalgam has been well documented to be the number one source of mercury in most people(19,20) and to commonly cause serious adverse health effects(20). Amalgam has also been documented to be the largest source of methyl mercury in most people, since mercury vapor and inorganic mercury have been shown to be methylated to methyl mercury in the mouth and intestines by bacteria, yeasts and other methyl donors(20). Mercury has also been found to be methylated in dental office disposal and sewer systems at levels orders of magnitude higher than in lakes and rain(4d).

Because of the extreme toxicity of mercury, only ½ gram is required to contaminate the ecosystem and fish of a 10 acre lake to the extent that a health warning would be issued by the government to not eat the fish[2]. Over half the rivers and lakes along with most bays in Florida have such health warnings(3) banning or limiting eating of fish, and most other states and 4 Canadian provinces have similar health warnings(16,29). Wisconsin has fish consumption warnings for over 250 lakes and rivers(5b) and Minnesota even more, as part of the total of over 50,000 such lakes with warnings(16) (over 33% of all significant U.S. lakes) and 15% of all U.S. river miles. All Great Lakes as well as most coastal bays and estuaries and large numbers of salt water fish carry similar health warnings, with 90% of Atlantic coastal miles and 100% of Gulf coastal miles covered by fish mercury warnings.

Nationwide the dental industry is the third largest user of mercury, using over 45 tons of mercury per year(26,14), and most of this mercury eventually ends up in the environment. Amalgam from dental offices is by far the largest contributor of mercury(over 35% of total) into sewers and sewer plants(4,13b,14,26), with mercury from replaced amalgam fillings and crown bases the largest source. When amalgam fillings are removed by standard practice methods using primary and secondary solids

collectors, approximately 60% of the amalgam metals by weight end up in sewer effluent(28b). As much as 10% of prepared new amalgam becomes waste. This mercury also accumulates in building sewer pipes and septic tanks or drain fields where used, creating toxic liabilities. Unlike Canada and most European countries such as Germany, Sweden, Switzerland, and Denmark which have much more stringent regulation of mercury that requires amalgam separators in dental offices(26,28,22), the U.S. does not and most dental offices do not have them. The discharge into sewers at a dental office per dentist using amalgam without amalgam separators is between 56 milligrams per day(14) and 270 milligrams per day(4,14,26). (some studies found much higher levels for some offices) For the U.S. with approximately 170,000 dentists working with amalgam(26), this would be from 2500 kg/yr to 12,000 kg/yr (between 3 to 13 tons/year of mercury into sewers and thus into streams, lakes, bays, and sewer sludge. In Canada the annual amount discharged is about 2 tons per year(28), with portions ending up in waters/fish, some in landfills and cropland, and in air emissions. The recently enacted regulations on dental office waste in Canada are expected to reduce emissions by at least 63% by 2005, compared to 2000(28).

Studies in Michigan, California, and Washington estimated that dental mercury is responsible for approximately 12 to14 % of mercury discharged to streams (5). An EPA study(13) found that dental office waste were responsible for similar levels of mercury in lakes, bays, and streams in other areas throughout the U.S. A Canadian study found similar levels of mercury contribution from dental offices into lakes and streams, and surveys of dental office disposal practices found the majority violated disposal regulations, and dangerous levels of mercury are accumulating in pipes and septic tanks from many offices(14,21,26). Dental amalgam mercury has been documented to be highly bioavailable in water(30).

The total discharge into sewers from dental amalgam at individual homes and businesses is second only to that from dental offices(14), since the average person with amalgam fillings excretes in body waste approximately 40 micrograms per day of mercury(6,7,8,20,31a). This has also been confirmed by medical labs(13c), such as Doctors Data Lab in Chicago and Biospectron in Sweden, which do thousands of stool tests per year and is consistent with studies measuring levels in residential sewers by municipalities(13b). In a Finnish study, over 20 % of those with amalgam excrete so much to home sewers that the EEU standard for mercury in sewers(50 ug/L) is exceeded (31). The amount of mercury excreted on average doubled for each additional 10 amalgam surfaces. The AMSA study adopted the conservative estimate of 28 micrograms per day for the average person with amalgam and 17 micrograms for the average of all those with and without amalgam. In the U.S. this would amount to approximately 2800 to 5500 kilograms per year into sewers or from 3 to 6 tons per year. Over 3 tons of mercury flows into the Chesapeake Bay annually from sewer plants, with numerous resulting fish consumption advisories for that area and similar for other areas(16). Thus the amount of mercury being excreted from dental amalgam is more than enough to cause dangerous levels of mercury in fish in most U.S. streams into which sewers empty. Studies by Oak Ridge National Laboratory(U.S. Dept. of Energy)(22,23) and other studies(14) have confirmed high levels of mercury in sewers and sewer sludge(generally 1 to 3 ppm in biosolids). Publically Owned Treatment Works( POTWs) do not have equipment to remove mercury in sewers other than any pretreatment requirements imposed by sewer districts. Mercury wastes are incompatible and must be removed at the source. In general POTWs are not equipped to remove or treat toxic chemicals.

MCES found that dental offices were responsible for over 40% of Mineapolis sewer mercury and excretion from those with amalgam responsible for over 80% of domestic mercury(4). According to an EPA study the majority of U.S. sewerage plants cannot meet the new EPA guideline for mercury discharge into waterways that was designed to prevent bioaccumulation in fish and wildlife due to household sewer mercury levels(15,13). The EPA discharge rule had been reduced due to a National Academy of Sciences report of July 2000 that found that even small levels of mercury in fish result in unacceptable risks of birth defects and developmental effects in infants(18).

ORNL studies have found that crops grown on land using land spread sewer sludge pick up high levels of mercury, and soil bacteria methylate inorganic mercury into methyl mercury, which is released into the air or landfill gas at high levels(22,23a). Sixty percent of the 5.6 million tons of sewage sludge generated each year are used for land application(27). The ORNL studies estimate that emissions of mercury from sludge amended soil amounts to from 5 to 6 tons of mercury per year (23a). Most dental amalgam waste from dental offices either goes into landfills or is incinerated (26). Much of the sewer sludge is also incinerated. Most of the mercury in materials that are incinerated goes out in the emissions, as most incinerators have no controls to remove mercury. High levels of mercury including the very toxic organic forms are being measured in rainfall

throughout the U.S.(24). High levels of the extremely toxic dimethyl and methylmercury forms of mercury are being found in landfill gas coming from landfills and appear to be a significant source of some of this(22,24). Bacteria in landfills have been found to be methylating elemental and inorganic mercury to the organic forms(22a,23a). Dental amalgam waste and mercury from human sewer sludge are major sources of mercury in some landfills and sludge is also used in landspreading on farms and other areas. Health Canada has also documented similar information on mercury emissions from amalgam and sewer sludge to waterways, crops, and air(28,29).

Additionally cremation of those with amalgam fillings adds to air emissions and deposition onto land and lakes. A study in Switzerland found that in that small country, cremation released over 65 kilograms of mercury per year as emissions, often exceeding site air mercury standards(9), while another Swiss study found mercury levels during cremation of a person with amalgam fillings as high as 200 micrograms per cubic meter(considerably higher than U.S. mercury standards). The amount of mercury in the mouth of a person with fillings was on average 2.5 grams, enough to contaminate 5 ten acre lakes to the extent there would be dangerous levels in fish(2,20). A Japanese study estimated mercury emissions from a small crematorium there as 26 grams per day(10). A study in Sweden found significant occupational and environmental exposures at crematoria, and since the requirement to install selenium filters mercury emission levels in crematoria have been reduced 85% (11). For the 70% of people in Britain who die and end up with their bodies being cremated, the mercury escapes into the atmosphere and contaminates waterways, soil, wildlife and food. Crematoria now contribute 16% of all the mercury released by industry and power plants in Britain (32), with levels projected to soon exceed emissions by power/industrial plants(32b). The 440,000 people cremated in Britain every year are estimated to discharge 1300kg of mercury(12) A study of assessing hair mercury in a group of staff at some of the 238 British crematoriums found that the groups hair mercury were significantly greater than that of controls(12). Government guidance calls on them to introduce new flue cleaning measures to help achieve a statutory target of a 50 per cent reduction by 2012.

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